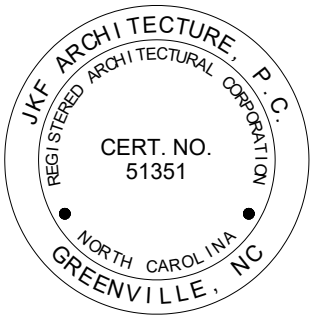
PROJECT MANUAL

# PITT COUNTY
# ADMINISTRATION BUILDING
## Greenville, NC

JKF Project No. 2024-14
September 15, 2026




Specification No.

JKF ARCHITECTURE
625 Lynndale Ct. Suite F
Greenville, NC 27858
252-355-1068 Phone
252-355-0216 Fax
jkf@jkf-arch.com

**ADVERTISEMENT FOR BIDS**

Sealed proposals for a single-prime General Construction Contract will be received from Pre-Qualified General Contractors by Pitt County Government, Attn.: Mr. Kenneth Brann, Assistant County Engineer, Developmental Services Building, 1717 West Fifth Street, Greenville, NC 27834, up to **3:00 p.m., Thursday, November 12, 2026**, in the Planning Conference Room and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of the**:**

**PITT COUNTY**
**NEW ADMINISTRATION BUILDIING**
**JKF PROJECT NO. 2024-14**

Bids will be received for Contract type – (single prime): Category-General. All proposals shall be lump sum. Pre-Qualified General Contractors:

- Daniels & Daniels Contracting Co., Inc.
- Hudson Brothers Construction Company
- Muter Construction
- Clancy & Theys Construction Company
- T.A. Loving Company
- J.M. Thompson Company
- Thomas Construction Group, LLC
- Monteith Construction Corp.
- WIMCO Corp.

**Pre-bid meeting** will be held for all bidders and all interested vendors on **Wednesday, October 21, 2026, at 10:00 AM** at the Pitt County Developmental Services Building, 1717 West Fifth Street, Greenville, NC 27834.

In accordance with GS133-3 procedures the following preferred brand items are being considered as Alternates by the owner for this project:

A. Preferred Brand Alternate: Door Hardware; Corbin-Russwin.

Complete plans and specifications for this project can be obtained at JKF ARCHITECTURE, 625 Lynndale Court, Suite F, Greenville, NC 27858, 252-355-1068, during normal office hours after October 4, 2026. Plans and specifications available for viewing at Dodge Data & Analytics, ConstructConnect, and Duncan Parnell-Greenville, NC.

Plan Deposit: $400 Hard Copy; No cost PDF when registered as bidder.

The Owner reserves the unqualified right to reject any and all proposals.

Signed:

**Kenneth Brann**
**Assistant County Engineer**

**PITT COUNTY**
**NEW ADMINISTRATION BUILDING**
**JKF PROJECT NO. 2024-14**

**TABLE OF CONTENTS**

**BIDDING REQUIREMENTS**

- NOTICE TO BIDDERS
- A701-1997 INSTRUCTIONS TO BIDDERS
- SUPPLEMENTAL INSTRUCTIONS TO BIDDERS
- A201-2007 GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION
- SUPPLEMENTARY GENERAL CONDITIONS
- GEOTECHNICAL REPORT
- STATEMENT OF SPECIAL INSPECTIONS

**BIDDING DOCUMENTS**

- BID FORM
- FORM OF BID BOND: AIA DOCUMENT A310-2017 (BY REFERENCE)
- FORM OF CONTRACT: AIA DOCUMENT A101-2017 (BY REFERENCE)
- PERFORMANCE BOND: AIA DOCUMENT A310-2017 (BY REFERENCE)
- PAYMENT BOND: AIA DOCUMENT A310-2017 (BY REFERENCE)
- NC SALES TAX FORMS
-


| Division | Section Title | Pages |
|---|---|---|
| **DIVISION 01 - GENERAL REQUIREMENTS** | | |
| 011000 | SUMMARY | 4 |
| 012100 | ALLOWANCES | 2 |
| 012200 | UNIT PRICES | 2 |
| 012300 | ALTERNATES | 2 |
| 012500 | SUBSTITUTION PROCEDURES | 3 |
| 012600 | CONTRACT MODIFICATION PROCEDURES | 2 |
| 012900 | PAYMENT PROCEDURES | 3 |
| 013100 | PROJECT MANAGEMENT AND COORDINATION | 7 |
| 013200 | CONSTRUCTION PROGRESS DOCUMENTATION | 5 |
| 013300 | SUBMITTAL PROCEDURES | 11 |
| 014000 | QUALITY REQUIREMENTS | 8 |
| 015000 | TEMPORARY FACILITIES AND CONTROLS | 9 |
| 016000 | PRODUCT REQUIREMENTS | 5 |
| 017300 | EXECUTION | 7 |
| 017419 | CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL | 4 |
| 017700 | CLOSEOUT PROCEDURES | 5 |
| 017823 | OPERATION AND MAINTENANCE DATA | 4 |
| 017839 | PROJECT RECORD DOCUMENTS | 3 |
| 019113 | GENERAL COMMISSIONING REQUIREMENTS | 14 |
| **DIVISION 03 - CONCRETE** | | |
| 033000 | CAST-IN-PLACE CONCRETE | 13 |
| **DIVISION 04 - MASONRY** | | |
| 042000 | UNIT MASONRY | 20 |

**DIVISION 05 - METALS**
051200..... STRUCTURAL STEEL FRAMING ..... 8
052100..... STEEL JOIST FRAMING ..... 4
053100..... STEEL DECKING ..... 5
054000..... COLD-FORMED METAL FRAMING ..... 7
055000..... METAL FABRICATIONS ..... 10
055113..... METAL PAN STAIRS ..... 8
055213..... PIPE AND TUBE RAILINGS ..... 7
055813..... COLUMN COVERS ..... 4
057313..... GLAZED DECORATIVE METAL RAILINGS ..... 10

**DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES**
061000..... ROUGH CARPENTRY ..... 4
061600..... SHEATHING ..... 5
062023..... INTERIOR FINISH CARPENTRY ..... 4
064113..... WOOD-VENEER-FACED ARCHITECTURAL CABINETS ..... 7
064116..... PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS ..... 6
064216..... FLUSH WOOD PANELING ..... 4

**DIVISION 07 - THERMAL AND MOISTURE PROTECTION**
071113..... BITUMINOUS DAMPPROOFING ..... 3
071700..... BENTONITE WATERPROOFING ..... 5
072100..... THERMAL INSULATION ..... 4
072500..... WEATHER BARRIERS ..... 2
074113..... STANDING-SEAM METAL ROOF PANELS ..... 13
074293..... SOFFIT PANELS ..... 7
074413..... METAL COMPOSITE MATERIAL WALL PANELS ..... 9
075423..... THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING ..... 13
076200..... SHEET METAL FLASHING AND TRIM ..... 9
077200..... ROOF ACCESSORIES ..... 4
077253..... SNOW GUARDS ..... 2
078413..... PENETRATION FIRESTOPPING ..... 5
078443..... JOINT FIRESTOPPING ..... 4
079200..... JOINT SEALANTS ..... 8

**DIVISION 08 - OPENINGS**
081113..... HOLLOW METAL DOORS AND FRAMES ..... 5
081213..... HOLLOW METAL FRAMES ..... 6
081416..... FLUSH WOOD DOORS ..... 5
083113..... ACCESS DOORS AND FRAMES ..... 3
084113..... ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS ..... 10
084126..... ALL-GLASS ENTRANCES AND STOREFRONTS ..... 5
084413..... GLAZED ALUMINUM CURTAIN WALLS ..... 8
085113..... ALUMINUM WINDOWS ..... 6
087100..... DOOR HARDWARE ..... 19
088000..... GLAZING ..... 9
088300..... MIRRORS ..... 4
088813..... FIRE-RESISTANT GLAZING ..... 7
088853..... SECURITY GLAZING ..... 6

089119..... FIXED LOUVERS..... 5

**DIVISION 09 - FINISHES**
092216..... NON-STRUCTURAL METAL FRAMING..... 6
092900..... GYPSUM BOARD..... 8
093013..... CERAMIC TILING..... 10
095113..... ACOUSTICAL PANEL CEILINGS..... 6
095114..... WOOD LINEAR VENEERED CEILING ASSEMBLY..... 3
095115..... INTEGRATED ACCOUSTICAL CEILING ASSEMBLIES..... 6
096513..... RESILIENT BASE AND ACCESSORIES..... 5
096519..... RESILIENT TILE FLOORING..... 5
096813..... TILE CARPETING..... 6
099113..... EXTERIOR PAINTING..... 5
099123..... INTERIOR PAINTING..... 7
099300..... STAINING AND TRANSPARENT FINISHING..... 6

**DIVISION 10 - SPECIALTIES**
101100..... VISUAL DISPLAY UNITS..... 4
101423..... PANEL SIGNAGE..... 6
102113..... PLASTIC TOILET COMPARTMENTS..... 4
102239..... FOLDING PANEL PARTITIONS..... 7
102800..... TOILET, BATH, AND LAUNDRY ACCESSORIES..... 5
104413..... FIRE PROTECTION CABINETS..... 4
104416..... FIRE EXTINGUISHERS..... 2
105300..... ..... 3
107516..... GROUND-SET FLAGPOLES..... 4

**DIVISION 12 - FURNISHINGS**
122413..... ROLLER WINDOW SHADES..... 4
123661..... SIMULATED STONE COUNTERTOPS..... 2
124816..... ENTRANCE FLOOR GRILLES..... 4

**DIVISION 14 - CONVEYING EQUIPMENT**
142400..... HYDRAULIC ELEVATORS..... 11

**DIVISION 31 - EARTHWORK**
313116..... TERMITE CONTROL..... 3

**DIVISION 32 - EXTERIOR IMPROVEMENTS**
321413..... INTERLOCKING CONCRETE UNIT PAVING..... 5
323120..... ALUMINUM SCREENING AND GATES..... 4

**DIVISION 21 - FIRE SUPPRESSION**
SEE IMEG TABLE OF CONTENTS

**DIVISION 22 - PLUMBING**
SEE IMEG TABLE OF CONTENTS

**DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**

SEE IMEG TABLE OF CONTENTS

**DIVISION 26 - ELECTRICAL**
SEE IMEG TABLE OF CONTENTS

**DIVISION 31, 32, 33 - CIVIL**
SEE RIVERS & ASSOCIATES TABLE OF CONTENTS

**END OF TABLE OF CONTENTS**



## NOTICE TO BIDDERS

Sealed proposals for a single-prime General Construction Contract will be received from Pre-Qualified General Contractors by Pitt County Government, Attn.: Mr. Kenneth Brann, Assistant County Engineer, Developmental Services Building, 1717 West Fifth Street, Greenville, NC 27834, up to **3:00 p.m., Thursday, November 12, 2026**, in the Planning Conference Room and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of the**:**

**PITT COUNTY**
**NEW ADMINISTRATION BUILDING**
**JKF PROJECT NO. 2024-14**

Bids will be received for Contract type – (single prime): Category-General. All proposals shall be lump sum.

**Pre-Qualified General Contractors:**

- Daniels & Daniels Contracting Co., Inc.
- Hudson Brothers Construction Company
- Muter Construction
- Clancy & Theys Construction Company
- T.A. Loving Company
- J.M. Thompson Company
- Thomas Construction Group, LLC
- Monteith Construction Corp.
- WIMCO Corp.

An open pre-bid meeting will be held for all bidders and all interested vendors on **Wednesday, October 21, 2026, at 10:00 AM** at the Pitt County Developmental Services Building, 1717 West Fifth Street, Greenville, NC 27834. The meeting will address project specific questions, issues, bidding procedures and bid forms.

The meeting is also to identify preferred brand alternates and their performance standards that the owner will consider for approval on this project.

In accordance with General Statute GS 133-3, Specifications may list one or more preferred brands as an alternate to the base bid in limited circumstances. Specifications containing a preferred brand alternate under this section must identify the performance standards that support the preference. Performance standards for the preference must be approved in advance by the owner in an open meeting. Any alternate approved by the owner shall be approved only where (i) the preferred alternate will provide cost savings, maintain or improve the functioning of any process or system affected by the preferred item or items, or both, and (ii) a justification identifying these criteria is made available in writing to the public.

In accordance with GS133-3 procedures the following preferred brand items are being considered as Alternates by the owner for this project:

A. Preferred Brand Alternate: Door Hardware; Corbin-Russwin.

Justification of any approvals will be made available to the public in writing no later than seven (7) days prior to bid date.

Complete plans, specifications and contract documents will be open for inspection in the offices of **JKF Architecture PC,** and in the plan rooms of Dodge Data & Analytics, Construct Connect, and Duncan Parnell-Greenville, NC or may be obtained by those prime bidders, upon deposit of $400 in cash or certified check. The full plan deposit will be returned to those bidders provided all documents are returned in good, usable condition within ten (10) days after the bid date. PDF sets only will be made available to all prime bidders at no cost provided they register with the Office of the Architect.

All contractors are hereby notified that they must have proper license as required under the state laws governing their respective trades.

General contractors are notified that Chapter 87, Article 1, General Statutes of North Carolina, will be observed in receiving and awarding general contracts. General contractors submitting bids on this project must have license classification for Building Contractor.

Under GS 87-1, a contractor that superintends or manages construction of any building, highway, public utility, grading, structure or improvement shall be deemed a “general contractor” and shall be so licensed. Therefore, a single prime project that involves other trades will require the single prime contractor to hold a proper General Contractors license.

Each proposal shall be accompanied by a cash deposit or a certified check drawn on some bank or trust company, insured by the Federal Deposit Insurance Corporation, of an amount equal to not less than five percent (5%) of the proposal, or in lieu thereof a bidder may offer a bid bond of five percent (5%) of the bid executed by a surety company licensed under the

laws of North Carolina to execute the contract in accordance with the bid bond. Said deposit shall be retained by the owner as liquidated damages in event of failure of the successful bidder to execute the contract within ten days after the award or to give satisfactory surety as required by law.

Contractors will comply with Federal and State E-Verify Requirements.

A performance bond and a payment bond will be required for one hundred percent (100%) of the contract price.

Payment will be made based on ninety-five percent (95%) of monthly estimates and final payment made upon completion and acceptance of work.

No bid may be withdrawn after the scheduled closing time for the receipt of bids for a period of 60 days.

The owner reserves the right to reject any or all bids and to waive informalities.

Signed:

***Mr. Kenneth Brann***
***Assistant County Engineer***

Architect: ***JKF ARCHITECTURE PC***
625 Lynndale Court, Suite F
Greenville, NC 27858
252-355-1068/0216 fax
jkf@jkf-arch.com

# AIA® Document A701™ – 1997

## *Instructions to Bidders*

**ADDITIONS AND DELETIONS:**
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

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

**THE ARCHITECT:**
*(Name, legal status and address)*
JKF Architecture PC
625 Lynndale Court, Suite F
Greenville, NC 27858

**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 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR



**AIA Document A701™ – 1997.** Copyright © 1970, 1974, 1978, 1987 and 1997 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:31:08 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA42)

## ARTICLE 1 DEFINITIONS

**§ 1.1** Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders, the bid form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

**§ 1.2** Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.

**§ 1.3** Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

**§ 1.4** A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

**§ 1.5** The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

**§ 1.6** An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

**§ 1.7** A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

**§ 1.8** A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

**§ 1.9** A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

## ARTICLE 2 BIDDER'S REPRESENTATIONS

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

**§ 2.1.1** The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction.

**§ 2.1.2** The Bid is made in compliance with the Bidding Documents.

**§ 2.1.3** The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

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

## ARTICLE 3 BIDDING DOCUMENTS

### § 3.1 COPIES

**§ 3.1.1** Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.

**AIA Document A701™ – 1997.** Copyright © 1970, 1974, 1978, 1987 and 1997 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:31:08 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA42)

**§ 3.1.2** Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the Advertisement or Invitation to Bid, or in supplementary instructions to bidders.

**§ 3.1.3** Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

**§ 3.1.4** The Owner and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

**§ 3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS**

**§ 3.2.1** The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

**§ 3.2.2** Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven days prior to the date for receipt of Bids.

**§ 3.2.3** Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

**§ 3.3 SUBSTITUTIONS**

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

**§ 3.3.2** No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

**§ 3.3.3** If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

**§ 3.3.4** No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

**§ 3.4 ADDENDA**

**§ 3.4.1** Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.

**§ 3.4.2** Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

**§ 3.4.3** Addenda will be issued no later than four days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

**§ 3.4.4** Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

**AIA Document A701™ – 1997.** Copyright © 1970, 1974, 1978, 1987 and 1997 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:31:08 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA42)

## ARTICLE 4 BIDDING PROCEDURES

### § 4.1 PREPARATION OF BIDS

**§ 4.1.1** Bids shall be submitted on the forms included with the Bidding Documents.

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

**§ 4.1.3** Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.

**§ 4.1.4** Interlineations, alterations and erasures must be initialed by the signer of the Bid.

**§ 4.1.5** All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

**§ 4.1.6** 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 make no 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 of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the Work. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

### § 4.2 BID SECURITY

**§ 4.2.1** Each Bid shall be accompanied by a bid security in the form and amount required if so stipulated in the Instructions to Bidders. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, 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. The amount of the bid security shall not be forfeited to the Owner in the event the Owner fails to comply with Section 6.2.

**§ 4.2.2** If a surety bond is required, it shall be written on AIA Document A310, Bid Bond, unless otherwise provided in the Bidding Documents, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

**§ 4.2.3** The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

### § 4.3 SUBMISSION OF BIDS

**§ 4.3.1** All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

**§ 4.3.2** Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

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

**§ 4.3.4** Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.

### § 4.4 MODIFICATION OR WITHDRAWAL OF BID

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

**AIA Document A701™ – 1997.** Copyright © 1970, 1974, 1978, 1987 and 1997 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:31:08 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA42)

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

**§ 4.4.3** Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

**§ 4.4.4** Bid security, if required, shall be in an amount sufficient for the Bid as resubmitted.

## ARTICLE 5 CONSIDERATION OF BIDS

### § 5.1 OPENING OF BIDS

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

### § 5.2 REJECTION OF BIDS

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

### § 5.3 ACCEPTANCE OF BID (AWARD)

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

**§ 5.3.2** The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

## 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, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

### § 6.2 OWNER'S FINANCIAL CAPABILITY

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

### § 6.3 SUBMITTALS

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

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

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

**AIA Document A701™ – 1997.** Copyright © 1970, 1974, 1978, 1987 and 1997 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:31:08 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA42)

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

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

## ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

### § 7.1 BOND REQUIREMENTS

**§ 7.1.1** If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources.

**§ 7.1.2** If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

**§ 7.1.3** If the Owner requires that bonds be secured from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.

### § 7.2 TIME OF DELIVERY AND FORM OF BONDS

**§ 7.2.1** The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

**§ 7.2.2** Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Both bonds shall be written in the amount of the Contract Sum.

**§ 7.2.3** The bonds shall be dated on or after the date of the Contract.

**§ 7.2.4** The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

## ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a Stipulated Sum.

**AIA Document A701™ – 1997.** Copyright © 1970, 1974, 1978, 1987 and 1997 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:31:08 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA42)

## SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

### GENERAL

AIA Document A701, Instructions to Bidders, 1997 Edition, is amended, supplemented, or voided as indicated herein.

### ARTICLE 2 - BIDDER'S REPRESENTATION

Add the following:

2.1.5 Bidder understands that all applicable state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

### ARTICLE 3 - BIDDING DOCUMENTS

3.1 COPIES

Change subparagraph 3.1.1 to read as follows:

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Invitation to Bid in the number and for the deposit sum, if any, stated therein. The deposit will be refunded to Bidders who comply with the requirements stated in the Notice to Bidders.

3.3 SUBSTITUTIONS

Change subparagraph 3.3.2 to read as follows:

3.3.2 Each prime contractor shall obtain written approval from the Designer for the use of substitute products, materials, or equipment claimed to be equal to those specified. Such approvals must be obtained prior to the bid opening. Applications for approval of substitutions shall be made by the prime contractor and not by subcontractors or material suppliers. The contractor shall submit substitution requests fourteen (14) calendar days prior to the bid date to the Architect. Requests shall include a complete list of all materials proposed for the substitution. Incomplete submittals shall not be considered. The Designer shall respond no less than 7 days prior to the bid date in an addendum. The contractor shall submit within 10 days following award of the contract a complete list of subcontractors and materials proposed for the job. This list shall have prior approved substitutions or materials specified. No deviations will be permitted.

### ARTICLE 4 - BIDDING PROCEDURE

4.2 BID SECURITY

Change subparagraph 4.2.1 to read as follows:

4.2.1 Each Bid shall be accompanied by a bid security in the form of a Certified Check, of the Bidder, or a Bid Bond, duly executed by the Bidder as principal and having a Surety Company thereon qualified to do business in the State of the project, and in an amount not less than 5% of the Base Bid amount, pledging that the Bidder will enter into a Contract with the Owner on the terms stated in the Bid and will, 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 within 10 days after offered a 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. The amount of the bid security shall not be forfeited to the Owner in the event the Owner fails to comply with Subparagraph 6.2.1.

**END OF SUPPLEMENTARY INSTRUCTIONS TO BIDDERS**

# AIA® Document A201™ – 2017

## *General Conditions of the Contract for Construction*

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.

**THE ARCHITECT:**
*(Name, legal status and address)*

JKF Architecture PC
625 Lynndale Court, Suite F
Greenville, NC 27858

**TABLE OF ARTICLES**


1 GENERAL PROVISIONS

2 OWNER

3 CONTRACTOR

4 ARCHITECT

5 SUBCONTRACTORS

6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

7 CHANGES IN THE WORK

8 TIME

9 PAYMENTS AND COMPLETION

10 PROTECTION OF PERSONS AND PROPERTY

11 INSURANCE AND BONDS

12 UNCOVERING AND CORRECTION OF WORK

13 MISCELLANEOUS PROVISIONS

14 TERMINATION OR SUSPENSION OF THE CONTRACT


Init.
/


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

## 15 CLAIMS AND DISPUTES



**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

## INDEX

(Topics and numbers in bold are Section headings.)


**Acceptance of Nonconforming Work**
9.6.6, 9.9.3, **12.3**
Acceptance of Work
9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, 12.3
**Access to Work**
**3.16**, 6.2.1, 12.1
Accident Prevention
10
Acts and Omissions
3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5, 10.2.8, 13.3.2, 14.1, 15.1.2, 15.2
Addenda
1.1.1
Additional Costs, Claims for
3.7.4, 3.7.5, 10.3.2, 15.1.5
**Additional Inspections and Testing**
9.4.2, 9.8.3, 12.2.1, **13.4**
**Additional Time, Claims for**
3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.6**
**Administration of the Contract**
3.1.3, **4.2**, 9.4, 9.5
Advertisement or Invitation to Bid
1.1.1
Aesthetic Effect
4.2.13
**Allowances**
**3.8**
**Applications for Payment**
4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.5.4, 9.6.3, 9.7, 9.10
Approvals
2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9, 3.12.10.1, 4.2.7, 9.3.2, 13.4.1
**Arbitration**
8.3.1, 15.3.2, **15.4**
**ARCHITECT**
**4**
**Architect**, Definition of
**4.1.1**
Architect, Extent of Authority
2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2, 9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1, 13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.1.4, 15.2.1
Architect, Limitations of Authority and Responsibility
2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4, 9.4.2, 9.5.4, 9.6.4, 15.1.4, 15.2
Architect's Additional Services and Expenses
2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4
Architect's Administration of the Contract
3.1.3, 3.7.4, 15.2, 9.4.1, 9.5
Architect's Approvals
2.5, 3.1.3, 3.5, 3.10.2, 4.2.7
Architect's Authority to Reject Work
3.5, 4.2.6, 12.1.2, 12.2.1
Architect's Copyright
1.1.7, 1.5
Architect's Decisions
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1, 13.4.2, 15.2
Architect's Inspections
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4
Architect's Instructions
3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2
Architect's Interpretations
4.2.11, 4.2.12
Architect's Project Representative
4.2.10
Architect's Relationship with Contractor
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.2, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2
Architect's Relationship with Subcontractors
1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3
Architect's Representations
9.4.2, 9.5.1, 9.10.1
Architect's Site Visits
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Asbestos
10.3.1
Attorneys' Fees
3.18.1, 9.6.8, 9.10.2, 10.3.3
Award of Separate Contracts
6.1.1, 6.1.2
**Award of Subcontracts and Other Contracts for Portions of the Work**
**5.2**
**Basic Definitions**
**1.1**
Bidding Requirements
1.1.1
Binding Dispute Resolution
8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5, 15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1
Bonds, Lien
7.3.4.4, 9.6.8, 9.10.2, 9.10.3
**Bonds, Performance, and Payment**
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**, 11.1.3, **11.5**
**Building Information Models Use and Reliance**
**1.8**
Building Permit
3.7.1
**Capitalization**
**1.3**
Certificate of Substantial Completion
9.8.3, 9.8.4, 9.8.5
**Certificates for Payment**



**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

4.2.1, 4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4
Certificates of Inspection, Testing or Approval
13.4.4
Certificates of Insurance
9.10.2
**Change Orders**
1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2
**Change Orders**, Definition of
**7.2.1**
**CHANGES IN THE WORK**
2.2.2, 3.11, 4.2.8, 7, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.5
**Claims**, Definition of
**15.1.1**
Claims, Notice of
1.6.2, 15.1.3
**CLAIMS AND DISPUTES**
3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4
Claims and Timely Assertion of Claims
15.4.1
**Claims for Additional Cost**
3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, **15.1.5**
**Claims for Additional Time**
3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, **15.1.6**
**Concealed or Unknown Conditions, Claims for**
**3.7.4**
Claims for Damages
3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3, 11.3.2, 14.2.4, 15.1.7
Claims Subject to Arbitration
15.4.1
**Cleaning Up**
**3.15**, 6.3
Commencement of the Work, Conditions Relating to
2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, **15.1.5**
**Commencement of the Work**, Definition of
**8.1.2**
**Communications**
3.9.1, **4.2.4**
Completion, Conditions Relating to
3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 14.1.2, 15.1.2
**COMPLETION, PAYMENTS AND**
**9**
Completion, Substantial
3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 15.1.2
Compliance with Laws
2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3
Concealed or Unknown Conditions
3.7.4, 4.2.8, 8.3.1, 10.3
Conditions of the Contract
1.1.1, 6.1.1, 6.1.4
Consent, Written
3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2, 15.4.4.2
**Consolidation or Joinder**
**15.4.4**
**CONSTRUCTION BY OWNER OR BY**
**SEPARATE CONTRACTORS**
1.1.4, **6**
**Construction Change Directive**, Definition of
**7.3.1**
**Construction Change Directives**
1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**, 9.3.1.1
Construction Schedules, Contractor's
3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
**Contingent Assignment of Subcontracts**
**5.4**, 14.2.2.2
**Continuing Contract Performance**
**15.1.4**
**Contract**, Definition of
**1.1.2**
**CONTRACT, TERMINATION OR**
**SUSPENSION OF THE**
5.4.1.1, 5.4.2, 11.5, **14**
Contract Administration
3.1.3, 4, 9.4, 9.5
Contract Award and Execution, Conditions Relating to
3.7.1, 3.10, 5.2, 6.1
Contract Documents, Copies Furnished and Use of
1.5.2, 2.3.6, 5.3
**Contract Documents**, Definition of
**1.1.1**
**Contract Sum**
2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4, **9.1**, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2, 12.3, 14.2.4, 14.3.2, 15.1.4.2, **15.1.5, 15.2.5**
**Contract Sum**, Definition of
**9.1**
Contract Time
1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5, 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1, 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2, 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5
**Contract Time**, Definition of
8.1.1
**CONTRACTOR**
**3**
**Contractor**, Definition of
**3.1, 6.1.2**
**Contractor's Construction and Submittal**
**Schedules**
**3.10**, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2
Contractor's Employees



**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.3, 14.1, 14.2.1.1
**Contractor's Liability Insurance**
**11.1**
Contractor's Relationship with Separate Contractors and Owner's Forces
3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4
Contractor's Relationship with Subcontractors
1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7, 9.10.2, 11.2, 11.3, 11.4
Contractor's Relationship with the Architect
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.4, 15.1.3, 15.2.1
Contractor's Representations
3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2
Contractor's Responsibility for Those Performing the Work
3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8
Contractor's Review of Contract Documents
3.2
Contractor's Right to Stop the Work
2.2.2, 9.7
Contractor's Right to Terminate the Contract
14.1
Contractor's Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3
Contractor's Superintendent
3.9, 10.2.6
Contractor's Supervision and Construction Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4
Coordination and Correlation
1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1
Copies Furnished of Drawings and Specifications
1.5, 2.3.6, 3.11
Copyrights
1.5, **3.17**
Correction of Work
2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**, 12.3, 15.1.3.1, 15.1.3.2, 15.2.1
**Correlation and Intent of the Contract Documents**
**1.2**
**Cost**, Definition of
**7.3.4**
Costs
2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.2, 12.1.2, 12.2.1, 12.2.4, 13.4, 14
**Cutting and Patching**
**3.14**, 6.2.5
Damage to Construction of Owner or Separate Contractors
3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damages, Claims for
3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2, 11.3, 14.2.4, 15.1.7
Damages for Delay
6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2
**Date of Commencement of the Work**, Definition of
**8.1.2**
**Date of Substantial Completion**, Definition of
**8.1.3**
**Day**, Definition of
**8.1.4**
Decisions of the Architect
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2, 14.2.2, 14.2.4, 15.1, 15.2
**Decisions to Withhold Certification**
9.4.1, **9.5**, 9.7, 14.1.1.3
Defective or Nonconforming Work, Acceptance, Rejection and Correction of
2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1
Definitions
1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1
**Delays and Extensions of Time**
**3.2**, **3.7.4**, 5.2.3, 7.2.1, 7.3.1, **7.4**, **8.3**, 9.5.1, **9.7**, 10.3.2, **10.4**, 14.3.2, **15.1.6**, 15.2.5
**Digital Data Use and Transmission**
**1.7**
Disputes
6.3, 7.3.9, 15.1, 15.2
**Documents and Samples at the Site**
**3.11**
**Drawings**, Definition of
**1.1.5**
Drawings and Specifications, Use and Ownership of
3.11
Effective Date of Insurance
8.2.2
**Emergencies**
**10.4**, 14.1.1.2, **15.1.5**
Employees, Contractor's
3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.3, 14.1, 14.2.1.1
Equipment, Labor, or Materials
1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Execution and Progress of the Work
1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1, 9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4
Extensions of Time
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2, 10.4, 14.3, 15.1.6, **15.2.5**



**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

**Failure of Payment**
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Faulty Work
(See Defective or Nonconforming Work)
**Final Completion and Final Payment**
4.2.1, 4.2.9, 9.8.2, **9.10**, 12.3, 14.2.4, 14.4.3
Financial Arrangements, Owner's
2.2.1, 13.2.2, 14.1.1.4
**GENERAL PROVISIONS**
**1**
**Governing Law**
**13.1**
Guarantees (See Warranty)
**Hazardous Materials and Substances**
10.2.4, **10.3**
Identification of Subcontractors and Suppliers
5.2.1
**Indemnification**
3.17, **3.18**, 9.6.8, 9.10.2, 10.3.3, 11.3
**Information and Services Required of the Owner**
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5, 9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4
**Initial Decision**
**15.2**
**Initial Decision Maker, Definition of**
1.1.8
Initial Decision Maker, Decisions
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Initial Decision Maker, Extent of Authority
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
**Injury or Damage to Person or Property**
**10.2.8**, 10.4
Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 12.2.1, 13.4
Instructions to Bidders
1.1.1
Instructions to the Contractor
3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2
**Instruments of Service**, Definition of
**1.1.7**
Insurance
6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5, **11**
**Insurance, Notice of Cancellation or Expiration**
**11.1.4, 11.2.3**
**Insurance, Contractor's Liability**
**11.1**
Insurance, Effective Date of
8.2.2, 14.4.2
**Insurance, Owner's Liability**
**11.2**
**Insurance, Property**
**10.2.5**, 11.2, 11.4, 11.5
Insurance, Stored Materials
9.3.2
**INSURANCE AND BONDS**
**11**
Insurance Companies, Consent to Partial Occupancy
9.9.1
Insured loss, Adjustment and Settlement of
11.5
Intent of the Contract Documents
1.2.1, 4.2.7, 4.2.12, 4.2.13
**Interest**
**13.5**
**Interpretation**
1.1.8, 1.2.3, **1.4**, 4.1.1, 5.1, 6.1.2, 15.1.1
Interpretations, Written
4.2.11, 4.2.12
Judgment on Final Award
15.4.2
**Labor and Materials, Equipment**
1.1.3, 1.1.6, **3.4**, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Labor Disputes
8.3.1
Laws and Regulations
1.5, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8, 15.4
Liens
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Limitations, Statutes of
12.2.5, 15.1.2, 15.4.1.1
Limitations of Liability
3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6, 4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3, 11.3, 12.2.5, 13.3.1
Limitations of Time
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7, 5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15, 15.1.2, 15.1.3, 15.1.5
**Materials, Hazardous**
10.2.4, **10.3**
Materials, Labor, Equipment and
1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2
Means, Methods, Techniques, Sequences and Procedures of Construction
3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2
Mechanic's Lien
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
**Mediation**
8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1, 15.4.1.1
**Minor Changes in the Work**
1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, **7.4**
**MISCELLANEOUS PROVISIONS**
**13**

**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

**Modifications**, Definition of
**1.1.1**
Modifications to the Contract
1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2
**Mutual Responsibility**
**6.2**
**Nonconforming Work, Acceptance of**
9.6.6, 9.9.3, **12.3**
Nonconforming Work, Rejection and Correction of
2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2
**Notice**
**1.6**, 1.6.1, 1.6.2, 2.1.2, 2.2.2., 2.2.3, 2.2.4, 2.5, 3.2.4, 3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4, 8.2.2 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1, 13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5, 15.1.6, 15.4.1
Notice of Cancellation or Expiration of Insurance
11.1.4, 11.2.3
**Notice of Claims**
1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, **15.1.3**, 15.1.5, 15.1.6, 15.2.8, 15.3.2, 15.4.1
Notice of Testing and Inspections
13.4.1, 13.4.2
Observations, Contractor's
3.2, 3.7.4
Occupancy
2.3.1, 9.6.6, 9.8
Orders, Written
1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2, 14.3.1
**OWNER**
**2**
**Owner**, Definition of
**2.1.1**
**Owner, Evidence of Financial Arrangements**
**2.2**, 13.2.2, 14.1.1.4
**Owner, Information and Services Required of the**
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4
Owner's Authority
1.5, 2.1.1, 2.3.32.4, 2.5, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1, 7.3.1, 8.2.2, 8.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.4, 11.5, 12.2.2, 12.3, 13.2.2, 14.3, 14.4, 15.2.7
**Owner's Insurance**
**11.2**
Owner's Relationship with Subcontractors
1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2
**Owner's Right to Carry Out the Work**
**2.5**, 14.2.2
**Owner's Right to Clean Up**
**6.3**
**Owner's Right to Perform Construction and to Award Separate Contracts**
**6.1**
**Owner's Right to Stop the Work**
**2.4**
Owner's Right to Suspend the Work
14.3
Owner's Right to Terminate the Contract
14.2, 14.4
**Ownership and Use of Drawings, Specifications and Other Instruments of Service**
1.1.1, 1.1.6, 1.1.7, **1.5**, 2.3.6, 3.2.2, 3.11, 3.17, 4.2.12, 5.3
**Partial Occupancy or Use**
9.6.6, **9.9**
**Patching, Cutting and**
**3.14**, 6.2.5
Patents
3.17
**Payment, Applications for**
4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.3, 14.2.4, 14.4.3
**Payment, Certificates for**
4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4
**Payment, Failure of**
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Payment, Final
4.2.1, 4.2.9, **9.10**, 12.3, 14.2.4, 14.4.3
**Payment Bond, Performance Bond and**
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**
**Payments, Progress**
9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4
**PAYMENTS AND COMPLETION**
**9**
Payments to Subcontractors
5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2
PCB
10.3.1
**Performance Bond and Payment Bond**
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**
**Permits, Fees, Notices and Compliance with Laws**
2.3.1, **3.7**, 3.13, 7.3.4.4, 10.2.2
**PERSONS AND PROPERTY, PROTECTION OF**
**10**
Polychlorinated Biphenyl
10.3.1
**Product Data**, Definition of
**3.12.2**
**Product Data and Samples, Shop Drawings**
3.11, **3.12**, 4.2.7
**Progress and Completion**
4.2.2, **8.2**, 9.8, 9.9.1, 14.1.4, 15.1.4
**Progress Payments**
9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4
**Project**, Definition of
**1.1.4**

**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

Project Representatives
4.2.10
**Property Insurance**
10.2.5, **11.2**
**Proposal Requirements**
1.1.1
**PROTECTION OF PERSONS AND PROPERTY**
**10**
Regulations and Laws
1.5, 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14, 15.2.8, 15.4
Rejection of Work
4.2.6, 12.2.1
Releases and Waivers of Liens
9.3.1, 9.10.2
Representations
3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1
Representatives
2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1
Responsibility for Those Performing the Work
3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10
Retainage
9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3
**Review of Contract Documents and Field Conditions by Contractor**
**3.2**, 3.12.7, 6.1.3
Review of Contractor's Submittals by Owner and Architect
3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2
Review of Shop Drawings, Product Data and Samples by Contractor
3.12
**Rights and Remedies**
1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1, 6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2, 12.2.4, **13.3**, 14, 15.4
**Royalties, Patents and Copyrights**
**3.17**
Rules and Notices for Arbitration
15.4.1
**Safety of Persons and Property**
**10.2**, 10.4
**Safety Precautions and Programs**
3.3.1, 4.2.2, 4.2.7, 5.3, **10.1**, 10.2, 10.4
**Samples**, Definition of
**3.12.3**
**Samples, Shop Drawings, Product Data and**
3.11, **3.12**, 4.2.7
**Samples at the Site, Documents and**
**3.11**
**Schedule of Values**
**9.2**, 9.3.1
Schedules, Construction
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Separate Contracts and Contractors
1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2
**Separate Contractors**, Definition of
**6.1.1**
**Shop Drawings**, Definition of
**3.12.1**
**Shop Drawings, Product Data and Samples**
3.11, **3.12**, 4.2.7
**Site, Use of**
**3.13**, 6.1.1, 6.2.1
Site Inspections
3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4
Site Visits, Architect's
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Special Inspections and Testing
4.2.6, 12.2.1, 13.4
**Specifications**, Definition of
**1.1.6**
**Specifications**
1.1.1, **1.1.6**, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14
Statute of Limitations
15.1.2, 15.4.1.1
Stopping the Work
2.2.2, 2.4, 9.7, 10.3, 14.1
Stored Materials
6.2.1, 9.3.2, 10.2.1.2, 10.2.4
**Subcontractor**, Definition of
**5.1.1**
**SUBCONTRACTORS**
**5**
Subcontractors, Work by
1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2, 9.6.7
**Subcontractual Relations**
**5.3**, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1
Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3, 9.8, 9.9.1, 9.10.2, 9.10.3
Submittal Schedule
3.10.2, 3.12.5, 4.2.7
**Subrogation, Waivers of**
6.1.1, **11.3**
**Substances, Hazardous**
**10.3**
**Substantial Completion**
4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2, 15.1.2
**Substantial Completion**, Definition of
**9.8.1**
Substitution of Subcontractors
5.2.3, 5.2.4
Substitution of Architect
2.3.3
Substitutions of Materials
3.4.2, 3.5, 7.3.8
**Sub-subcontractor**, Definition of
**5.1.2**
Subsurface Conditions
3.7.4



**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

**Successors and Assigns**
**13.2**
**Superintendent**
**3.9**, 10.2.6
**Supervision and Construction Procedures**
1.2.2, **3.3**, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4
Suppliers
1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6, 9.10.5, 14.2.1
Surety
5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2, 15.2.7
Surety, Consent of
9.8.5, 9.10.2, 9.10.3
Surveys
1.1.7, 2.3.4
**Suspension by the Owner for Convenience**
**14.3**
Suspension of the Work
3.7.5, 5.4.2, 14.3
Suspension or Termination of the Contract
5.4.1.1, 14
**Taxes**
3.6, 3.8.2.1, 7.3.4.4
**Termination by the Contractor**
**14.1**, 15.1.7
**Termination by the Owner for Cause**
5.4.1.1, **14.2,** 15.1.7
**Termination by the Owner for Convenience**
**14.4**
Termination of the Architect
2.3.3
Termination of the Contractor Employment
14.2.2

**TERMINATION OR SUSPENSION OF THE CONTRACT**
**14**
**Tests and Inspections**
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 10.3.2, 12.2.1, **13.4**
**TIME**
**8**
**Time, Delays and Extensions of**
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5
Time Limits
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2, 5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15.1.2, 15.1.3, 15.4
**Time Limits on Claims**
3.7.4, 10.2.8, 15.1.2, 15.1.3
Title to Work
9.3.2, 9.3.3
**UNCOVERING AND CORRECTION OF WORK**
**12**
**Uncovering of Work**
**12.1**
Unforeseen Conditions, Concealed or Unknown
3.7.4, 8.3.1, 10.3
Unit Prices
7.3.3.2, 9.1.2
Use of Documents
1.1.1, 1.5, 2.3.6, 3.12.6, 5.3
**Use of Site**
**3.13**, 6.1.1, 6.2.1
**Values, Schedule of**
**9.2**, 9.3.1
Waiver of Claims by the Architect
13.3.2
Waiver of Claims by the Contractor
9.10.5, 13.3.2, **15.1.7**
Waiver of Claims by the Owner
9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, **15.1.7**
Waiver of Consequential Damages
14.2.4, 15.1.7
Waiver of Liens
9.3, 9.10.2, 9.10.4
**Waivers of Subrogation**
6.1.1, **11.3**
**Warranty**
**3.5**, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2, 15.1.2
Weather Delays
8.3, 15.1.6.2
**Work**, Definition of
**1.1.3**
Written Consent
1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3, 13.2, 13.3.2, 15.4.4.2
Written Interpretations
4.2.11, 4.2.12
Written Orders
1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1



**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

## ARTICLE 1 GENERAL PROVISIONS

### § 1.1 Basic Definitions

#### § 1.1.1 The Contract Documents

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

#### § 1.1.2 The Contract

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

#### § 1.1.3 The Work

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

#### § 1.1.4 The Project

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

#### § 1.1.5 The Drawings

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

#### § 1.1.6 The Specifications

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

#### § 1.1.7 Instruments of Service

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

#### § 1.1.8 Initial Decision Maker

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

### § 1.2 Correlation and Intent of the Contract Documents

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

**§ 1.2.1.1** The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

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

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

### § 1.3 Capitalization

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

### § 1.4 Interpretation

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

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

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

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

### § 1.6 Notice

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

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

### § 1.7 Digital Data Use and Transmission

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

### § 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

## ARTICLE 2 OWNER

### § 2.1 General

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

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

### § 2.2 Evidence of the Owner's Financial Arrangements

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

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

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

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

### § 2.3 Information and Services Required of the Owner

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

**§ 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.


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

### § 3.2 Review of Contract Documents and Field Conditions by Contractor

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

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

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

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

### § 3.3 Supervision and Construction Procedures

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

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

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

### § 3.4 Labor and Materials

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

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

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

**§ 3.5 Warranty**

**§ 3.5.1** The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

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

**§ 3.6 Taxes**

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

**§ 3.7 Permits, Fees, Notices and Compliance with Laws**

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

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

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

**§ 3.7.4 Concealed or Unknown Conditions**

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

**§ 3.7.5** If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

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

### § 3.8 Allowances

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

**§ 3.8.2** Unless otherwise provided in the Contract Documents,

- **.1** allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- **.3** whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

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

### § 3.9 Superintendent

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

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

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

### § 3.10 Contractor's Construction and Submittal Schedules

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

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

**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

**§ 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.


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

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

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

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

### § 3.13 Use of Site

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

### § 3.14 Cutting and Patching

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

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

### § 3.15 Cleaning Up

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

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

### § 3.16 Access to Work

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

### § 3.17 Royalties, Patents and Copyrights

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

### § 3.18 Indemnification

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

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

## ARTICLE 4 ARCHITECT

### § 4.1 General

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

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

### § 4.2 Administration of the Contract

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

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

**§ 4.2.3** On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

**§ 4.2.4 Communications**

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

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

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

**§ 4.2.7** The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

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

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

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

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

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

**§ 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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

**§ 5.4 Contingent Assignment of Subcontracts**

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

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

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

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

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

## ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

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

**§ 6.1.3** The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

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

**§ 6.2 Mutual Responsibility**

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

**§ 6.2.2** If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

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;


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

.4 As provided in Section 7.3.4.

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

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

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

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

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

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

**§ 7.3.9** Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

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

### § 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

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.


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

### § 9.3 Applications for Payment

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

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

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

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

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

### § 9.4 Certificates for Payment

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

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

### § 9.5 Decisions to Withhold Certification

**§ 9.5.1** The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

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.


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

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

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

### § 9.7 Failure of Payment

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

### § 9.8 Substantial Completion

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

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

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

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

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

### § 9.9 Partial Occupancy or Use

**§ 9.9.1** The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

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

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

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

**§ 9.10 Final Completion and Final Payment**

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

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

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

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

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

.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.

**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

### § 10.3 Hazardous Materials and Substances

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

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

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

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

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

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

### § 10.4 Emergencies

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

## ARTICLE 11 INSURANCE AND BONDS

### § 11.1 Contractor's Insurance and Bonds

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

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

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

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

**§ 11.2 Owner's Insurance**

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

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

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

**§ 11.3 Waivers of Subrogation**

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

Init.
/

**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**



(3B9ADA30)

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

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

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

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

**§11.5 Adjustment and Settlement of Insured Loss**

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

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

## ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

**§ 12.1 Uncovering of Work**

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

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

### § 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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

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.


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**
(3B9ADA30)

## ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

### § 14.1 Termination by the Contractor

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

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

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

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

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

### § 14.2 Termination by the Owner for Cause

**§ 14.2.1** The Owner may terminate the Contract if the Contractor

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

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

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

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

**§ 14.2.4** If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance,


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

**§ 14.3 Suspension by the Owner for Convenience**

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

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

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

**§ 14.4 Termination by the Owner for Convenience**

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

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

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

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

**ARTICLE 15 CLAIMS AND DISPUTES**

**§ 15.1 Claims**

**§ 15.1.1 Definition**

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

**§ 15.1.2 Time Limits on Claims**

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

**§ 15.1.3 Notice of Claims**

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



**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

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

**§ 15.1.4 Continuing Contract Performance**

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

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

**§ 15.1.5 Claims for Additional Cost**

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

**§ 15.1.6 Claims for Additional Time**

**§ 15.1.6.1** If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

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

**§ 15.1.7 Waiver of Claims for Consequential Damages**

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

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

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

**§ 15.2 Initial Decision**

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

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

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

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

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

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

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

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

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

**§ 15.3 Mediation**

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

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

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


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:**

**§ 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.


**AIA Document A201™ – 2017.** Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 14:36:24 on 09/09/2017 under Order No. 6959739021 which expires on 03/16/2018, and is not for resale.
**User Notes:** (3B9ADA30)

**SUPPLEMENTARY GENERAL CONDITIONS**
**OF THE CONTRACT FOR CONSTRUCTION**

**GENERAL**

AIA Document A201, General Conditions of the Contract for Construction 2017 Edition, is amended, supplemented, or voided as indicated herein.

**ARTICLE 1- GENERAL PROVISIONS**

Add new Section 1.1.5.1:

§ 1.1.5.1 Contractor shall be provided with 8 complete sets of the Contract Documents for use during the Project.

Add new Section 1.2.1.2:

§ 1.2.1.2 In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes, and ordinances, the Contractor shall (i) provide the better quality or greater quantity of Work or (ii) comply with the more stringent requirement; either or both in accordance with the Architect's interpretation. The terms and conditions of this Section 1.2.1.2, however, shall not relieve the Contractor of any obligations set forth in Sections 3.2 and 3.7.

**ARTICLE 2 - OWNER**

**§ 2.6 Extent of Owner Rights**

Add new Section 2.6:

**§ 2.6 Extent of Owner Rights**
The rights stated in this Article 2 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (i) granted in the Contract Documents, (ii) at law, or (iii) in equity. In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences, or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

**ARTICLE 3 – CONTRACTOR**

**§ 3.2 General**

Add new Section 3.1.4:

§ 3.1.4 As required by N.C.G.S. §143-133.3 and related state and federal laws, the Contractor and its Subcontractors, shall comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes, including, without limitation, the requirement for each employer with more than 25 employees in North Carolina to verify the work authorization of its employees through the federal E-Verify system.

**§ 3.2 Review of Contract Documents and Field Conditions by Contractor**

Add the following at the end of Section 3.2.1:

Prior to execution of the Agreement, the Contractor has evaluated and satisfied itself as to the conditions and limitations under which the Work is to be performed, including, without limitation, (i) the location, condition, layout, and nature of the Project site and surrounding areas, (ii) generally prevailing climatic conditions, (iii) anticipated labor supply and costs, (iv) availability and cost of materials, tools, and equipment, and (v) other similar issues. The Owner assumes no responsibility or liability for the physical condition or safety of the Project site. Except as set forth in Section 10.3, the Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or the Contract Time in connection with any failure by the Contractor to have complied with the requirements of this Section 3.2.1.

**3.18 Indemnification**

Add new Sections 3.18.3 and 3.18.4:

§ 3.18.3 To the fullest extent permitted by law, the Contractor's indemnity obligations under this Section 3.18 shall

also specifically include, without limitation, all fines, penalties, damages, liability, costs, expenses (including, without limitation, reasonable attorneys' fees), and punitive damages (if any) arising out of, or in connection with, any (i) violation of or failure to comply with any law, statute, ordinance, rule, regulation, code, or requirement of a public authority that bears upon the performance of the Work by the Contractor, a Subcontractor, or any person or entity for whom either is responsible, (ii) means, methods, procedures, techniques, or sequences of execution or performance of the Work, and (iii) failure to secure and pay for permits, fees, approvals, licenses, and inspections as required under the Contract Documents, or any violation of any permit or other approval of a public authority applicable to the Work, by the Contractor, a Subcontractor, or any person or entity for whom either is responsible.

§ 3.18.4 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless each person and entity indemnified under this Section 3.18 from and against any costs and expenses (including reasonable attorneys' fees) incurred by any of the indemnitees in enforcing any of the Contractor's defense, indemnity, and hold-harmless obligations under this Contract.

## ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

Delete Section 6.1.4 in its entirety.

## ARTICLE 7 - CHANGES IN THE WORK

### 7.1 General

Add new Section 7.1.4:

§ 7.1.4 Except as permitted in Section 7.3, a change in the Contract Sum or the Contract Time shall be accomplished only by Change Order. Accordingly, no course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work, and no claim that Owner has been unjustly enriched by any alteration of or addition to the Work, whether or not there is, in fact, any unjust enrichment to the Work, shall be the basis of any claim to an increase in any amounts due under the Contract Documents or a change in any time period provided for in the Contract Documents.

### 7.2 Change Orders

Add new Sections 7.2.2 and 7.2.3:

§ 7.2.2 Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, without limitation, all direct and indirect costs and damages associated with such change and any and all adjustments to the Contract Sum and the Contract Time.

§ 7.2.3. The allowances for overhead and profit for adjustments to the Contract Sum for all Change Orders and, if applicable Construction Change Directives, shall be as follows:

.1 Changes in the Work requiring an increase to the Contract Sum shall allow for a combined overhead and profit not to exceed 15% of the net cost increase except where the change involves a Subcontractor in which case overhead and profit shall not exceed 15% for the Subcontractor and 10% for the Contractor.

.2 Changes in the Work requiring a decrease to the Contract Sum shall include a combined overhead and profit deduct of 10% in the net cost from the Subcontractor and 10% from the Contractor.

.3 Payroll burden shall not exceed 30% of the direct employee cost for any changes.

.4 No additional allowances shall be made for overhead and profit for work requiring a change to the Contract Sum where adjustments to the Contract Sum are covered by unit prices quoted in the Bid Form.

.5 The actual costs of labor expended on the project site; labor expended in coordination, change order negotiation, record document maintenance, shop drawing revision or other tasks necessary to the administration of the project are considered overhead whether they

take place in an office or on the project site. Additional cost for General Conditions may be allowed when a significant extension of time is required, provided the Contractor provides a complete breakdown of all General Conditions with initial Schedule of Values and it was approved by the Architect.

**ARTICLE 8 - TIME**

**§ 8.2 Progress and Completion**

Add new Section 8.2.4

§ 8.2.4 If the progress or completion of the Work is delayed by any fault, neglect, act, or failure to act on the part of the Contractor or anyone acting for or on behalf of the Contractor, then the Contractor shall, in addition to all of the other obligations imposed by the Owner, work such overtime and/or require its Subcontractors to work such overtime as may be necessary to make up for all time lost and to avoid delay in the progress and completion of the Work. The Contractor shall be entitled to no adjustment in the Contract Sum on account of the performance of overtime work by the Contractor and/or its Subcontractors to maintain or recover the schedule.

**§ 8.3 Delays and Extensions of Time**

Add new Sections 8.3.1.1 and 8.3.1.2:

§ 8.3.1.1 Time extensions will not be granted for rain, wind, snow or other natural phenomena of normal intensity for the locality where the Work is performed. For purpose of determining extent of delay attributable to adverse weather or unusual weather phenomena, a determination shall be made by comparing the weather for the contract period involved with the average of the preceding five (5) year climatic range during the same time interval based on the National Oceanic and Atmospheric Administration National Weather Service statistics for the locality where Work is performed and on daily weather logs kept on the job site by the Contractor reflecting the effect of the weather on progress of the Work and initialed by the Architect's representative. No weather delays shall be considered after the building is dried in unless work claimed to be delayed is on the critical path of the baseline schedule or approved updated schedule. Time extensions for weather delays, acts of God, labor disputes, fire, delays in transportation, unavoidable casualties, or other delays which are beyond the control of the Owner do not entitle the Contractor to compensable damages for delays. Any Contractor claim for compensable damages for delays is limited to delays caused solely by the Owner or its agents. Contractor caused delays shall be accounted for before Owner or designer caused delays in the case of concurrent delays.

§ 8.3.1.2 If the Contractor is delayed at any time in the progress of the Work solely by any act or negligence of the Owner, the Architect, or by any consultant or employee of either; by any separate contractor employed by the Owner; by changes ordered in the Work; by labor disputes at the project site; by abnormal weather conditions not reasonably anticipated for the locality where the work is performed; by unavoidable casualties; by any causes beyond the contractor's control; or by any other causes which the Architect and Owner determine may justify the delay, then the Contract Time may be extended by Change Order only for the time which the Architect and Owner may determine is reasonable.

Replace Sections 8.3.2 and 8.3.3 in their entirety as follows:

§ 8.3.2 Any Claim seeking an extension to the Contract Time and/or damages for alleged Owner-caused delay shall be made in strict accordance with the requirements of Article 15. The failure to make a Claim for an extension to the Contract Time and/or for damages for alleged Owner-caused delay in strict accordance with Article 15 shall be deemed an irrevocable waiver of the Claim.

§ 8.3.3 Any award of damages to the Contractor, a Subcontractor, a Sub-Subcontractor, their agents or employees, or any other persons or entities performing portions of the Work for alleged Owner-caused delay shall include overhead and profit in accordance with the allowances set forth in Section 7.2.3. Under no circumstances shall the Contractor or any Subcontractor, Sub-Subcontractor, their agents or employees, or any other persons or entities performing portions of the Work be entitled to recover alleged unabsorbed home office overhead under the *Eichleay* formula or any other formula, it being expressly agreed by the Contractor that any alleged unabsorbed home office overhead is included within the allowances set forth in Section 7.2.3. By executing the Agreement, the Contractor waives Claims for alleged unabsorbed home office overhead under the *Eichleay* formula or any other computation.

**§ 8.4 Liquidated Damages**

Add new Section 8.4:

**§ 8.4 Liquidated Damages**

§ 8.4.1 The Contractor shall commence the Work on the date indicated in the Agreement and shall complete all work hereunder within five-hundred forty (540) consecutive calendar days and subsequently agreed to in the Agreement.

§ 8.4.2 For each day in excess of the agreed to number of calendar days, the Contractor shall pay to the Owner the sum of One-Thousand Dollars ($1,500.00) as liquidated damages reasonably estimated in advance to cover the losses to be incurred by the Owner by reason of failure of the Contractor to complete the Work within the time specified, such time being in essence of this contract and a material consideration thereof.

§ 8.4.3 The Contractor and the Owner expressly agree that the Contract contemplates the potential apportionment of Project delay, and the Architect shall be the judge as to division of responsibility between the entities responsible for the delay and shall apportion the amount of liquidated damages to be paid by each entity responsible for the delay according to delay caused by any or all of them.

**ARTICLE 9 - PAYMENTS AND COMPLETION**

**§ 9.3 Applications for Payment**

Add the following to Sections 9.3.1:

§ 9.3.1.3 Applications for payment shall be made monthly on the AIA Document G702/G703. Applications shall be based on the contract prices of labor and materials incorporated into the Work and of materials suitably stored and secured less a 5% retainage, and less the aggregate of previous payments. Change Orders when approved shall be listed at the bottom of the last sheet or summary sheet, if applicable, of the payment application.

§ 9.3.1.4 After the first Certificate of Payment has been issued by the Architect and paid by the Owner, on all subsequent applications, the Contractor shall sign the affidavit on the Payment Application form.

§ 9.3.1.5 The completed Payment Application form(s) (4 copies) shall be submitted to the Architect's representative on or about the 5th day of each month, but not later than 10 days before the date established for each progress payment, for work completed to the last day of the previous month.

Replace Section 9.3.2 in its entirety as follows:

§ 9.3.2: When payment is made on account of stored materials and equipment, such materials must be stored on the Owner's property, and the requests for payments shall be accompanied by invoices or bills of sale or other evidence to establish the Owner's title to such materials and equipment. Responsibility for such stored materials and equipment shall remain with the Contractor regardless of ownership title. Such stored materials and equipment shall not be removed from the Owner's property. Should the space for storage on-site be limited, the Contractor, at its option, shall be permitted to store such materials and/or equipment in a suitable space off-site. Should the Contractor desire to include any such materials or equipment in its application for payment, they must be stored in the name of the Owner in a commercial warehouse approved by the Architect and located as close to the site as possible. The warehouse selected must be approved by the Contractor's bonding and insurance companies; the material to be paid for shall be assigned to the Owner and shall be inspected by the Architect. Upon approval by the Architect of the storage facilities and materials and equipment, payment therefore will be certified. Responsibility for such stored materials and equipment shall remain with the Contractor. Such stored materials and equipment shall not be moved except for transportation to the Project site. Under certain conditions, the Architect may approve storage of materials at the point of manufacture, which conditions shall be approved by the Architect and the Owner prior to approval for the storage and shall include an agreement by the storing party which unconditionally gives the absolute right to possession of the materials at anytime. Bond, security, and insurance protection for materials stored on or off-site shall continue to be the responsibility of the Contractor, and Contractor shall provide evidence of bond, security, or insurance protection upon request by the Architect or the Owner.

**§ 9.4 Certificates for Payment**

Add new Sections 9.4.3 and 9.4.4:

§ 9.4.3 If, subsequent to issuing any certificate pursuant to this Section 9.4, Architect should determine that any

previous certificate was in error (whether by review of additional conditions or documents, discovery of a mathematical error, or any other reason), then Architect may issue a Revised Certificate for Payment, setting forth the changes in the amounts due to the Contractor as well as the reason for such revision.

§ 9.4.4 The Owner may withhold payment to the Contractor, notwithstanding the Architect's certification or issuance of a Certificate for Payment, if necessary in the Owner's sole discretion to protect the Owner from loss due to any of the reasons set forth in Section 9.5.1. The Owner shall also have the right, notwithstanding the Architect's certification or issuance of a Certificate for Payment, to withhold from payment to the Contractor such amounts as permitted by N.C.G.S. §143-134.1.

**§ 9.6 Progress Payments**

Add the following Subsection to Section 9.6.1 as follows:

.1 Owner shall make progress payments to the Contractor within 28 days from receipt of Architect's Certificate for Payment.

**§ 9.8 Substantial Completion**

Add the following Subsections 9.8.5:

.1 No partial payments will be made after the time fixed for the completion of the Work or the time to which completion may be extended under the terms of the Contract, until the full and final completion and acceptance of all Work herein is agreed upon.

.2 Upon Substantial Completion of the entire Work, the Contractor may submit a payment application requesting a sum sufficient to increase the total payment to 97.5 percent of the Contract Sum, balance to be paid upon final completion and acceptance except as otherwise specified.

.3 Except on projects where there is no Performance Bond required, a request to increase the total payments to 97.5 percent of the Contract Sum shall be accompanied by the properly executed AIA form G707A, "Consent of Surety to Reduction in or Partial Releases of Retainage."

**ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY**

**§ 10.3 Hazardous Materials and Substances**

Delete Section 10.3.3 in its entirety.

Delete Section 10.3.6 in its entirety.

**ARTICLE 11 – INSURANCE AND BONDS**

Replace Article 11 in its entirety as follows:

**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 this Section 11.1 or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the insurance required by the Contract Documents from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2.

**§ 11.1.2** Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than Two Million Dollars ($2,000,000.00) each occurrence, Two Million Dollars ($2,000,000.00) general aggregate, and Two Million Dollars ($2,000,000.00) aggregate for products-completed operations hazard, and Five Million Dollars ($5,000,000.00) for Excess/Umbrella Liability, providing coverage for claims including:

**.1** damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;

**.2** personal and advertising injury;

**.3** damages because of physical damage to or destruction of tangible property, including the loss of use of such property;

**.4** bodily injury or property damage arising out of completed operations; and

**.5** the Contractor's indemnity obligations under Section 3.18.

**§ 11.1.3** Automobile Liability covering vehicles owned by the Contractor and non-owned vehicles used by the Contractor, with policy limits of not less than One Million Dollars ($1,000,000.00) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance, and use of those motor vehicles along with any other statutorily required automobile coverage.

**§ 11.1.4** In no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

**§ 11.1.5** Workers' Compensation at statutory limits.

**§ 11.1.6** Employers' Liability with policy limits not less than One Million Dollars ($1,000,000.00) each accident, One Million Dollars ($1,000,000.00) each employee, and One Million Dollars ($1,000,000.00) policy limit.

**§ 11.1.7** If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than One Million Dollars ($1,000,000.00) per claim and Two Million Dollars ($2,000,000.00) in the aggregate.

**§ 11.1.8** The Contractor shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Contractor's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed or materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section 11.1.1, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

**§ 11.1.9** If the insurance required by Section 11.1 is subject to deductibles or self-insured retentions, the Contractor shall be responsible for all loss not covered because of such deductibles or retentions

**§ 11.1.10** The Contractor shall provide certificates of insurance acceptable to the Owner and Architect evidencing compliance with the requirements in Section 11.1 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the period required by Section 11.1.1. The certificates will show the Owner**,** the Architect, and the Architect's consultants as additional insured on the Contractor's Commercial General Liability and Excess or Umbrella Liability policies. Each policy shall contain a provision that the policy shall not be canceled or allowed to expire until at least 30-days' prior written notice, by certified mail, return receipt requested, has been given to the Owner and Architect. Upon the request of Owner or Architect, Contractor shall provide a copy of all insurance policies required by the Contract Documents. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

**§ 11.1.11** The Contractor shall disclose to the Owner and the Architect any deductible or self- insured retentions applicable to any insurance required to be provided by the Contractor.

**§ 11.1.12** To the fullest extent permitted by law, the Contractor shall cause the commercial liability coverage required by this Section 11.1 to include (1) the Owner**,** the Architect, and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

**§ 11.1.13** 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 this Section 11.1, the Contractor shall provide notice to the Owner and Architect 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.

**§ 11.1.14 Performance and Payment Bonds**
The Contractor shall furnish bonds covering the faithful performance of the Contract and payment of obligations arising thereunder. The bonds shall be written on forms consistent with North Carolina law and as required by the Contract Documents and shall be executed by a responsible surety licensed in North Carolina and acceptable to the Owner. The Contractor shall deliver the bonds required by this Section 11.1.14 to the Owner and Architect no later than fifteen (15) days following receipt of the Notice of Award. 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 Power of Attorney.

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

**§ 11.2 Owner's Insurance**
**§ 11.2.1 Owner's Liability Insurance**
The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

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

**§ 11.4 Adjustment and Settlement of Insured Loss**
**§ 11.4.1** A loss insured under the property insurance required by the Contract Documents shall be adjusted by the Owner and made payable to the Owner for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of section 11.4.2. The Owner shall pay the insureds their just shares of insurance proceeds received by the Owner, and the Architect and the Contractor shall make payments to their consultants and Subcontractors in similar manner, and the Contractor shall, by appropriate written agreements, require Subcontractors to make payments to their Sub-subcontractors in a similar manner.

**§ 11.4.2** 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 fourteen (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 the 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 the 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 CORRECTING WORK

**§ 12.2 Correction of Work**

Replace Section 12.2.2.1 in its entirety as follows:

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one (1) 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 or its surety shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor or its surety a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition, but such notice obligation shall not be deemed to relieve the Contractor of its obligations to make all corrections necessary in connection with a master list of deficiencies prepared by the Owner and submitted to the Contractor at the end of the one (1) year correction period for all the deficiencies noted by the Owner during such time, which corrections the Contractor shall be obligated to timely make at its expense. At the end of the one (1) year period for correction of Work, if the Owner has noticed a deficiency and failed 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.

**ARTICLE 13 – MISCELLANEOUS PROVISIONS**

**§13.2 Successors and Assigns**

Add the following new Section 13.2.3:

§ 13.2.3 The Contractor shall not assign, transfer, convey, or otherwise dispose of the Contract, or of its legal right, title, or interest in or to the same or obligations or warranties made thereunder, in whole or in part, without the prior written consent of the Owner. The Contractor shall not assign by power of attorney or otherwise any monies due it and payable under this Contract without the prior written consent of the Owner. Such consent, if given, shall in no way relieve the Contractor from any of the obligations under the Contract Documents. The Owner shall not be bound to abide by or observe the requirements of any such assignment. The Change in Control of the Contractor, whether by merger, stock or membership interest, or partnership interest sale, or a sale of all or substantially all of the assets of the Contractor, shall constitute an assignment, transfer, conveyance, or other disposal of the Contract requiring the prior written consent of the Owner. "Change in Control" for purposes of the preceding sentence means the sale or transfer, howsoever effected, of fifty percent (50%) or more of the equity interests of the Contractor to another person or entity, the sale of all or substantially all of the assets of the Contractor, or any other transaction or series of related transactions in which the voting or management control of the Contractor as it exists as of the Effective Date of the Contract is transferred to any other person or entity or group of persons or entities.

**§ 13.6 General Provisions**

Add the following new Section 13.6:

**§13.6 General Provisions**

§ 13.6.1 All personal pronouns used in the Contract Documents, whether used in the masculine, feminine, or neuter gender, shall include all other genders; and the singular shall include the plural and vice versa. Titles of articles, sections, and subsections are for convenience only and neither limit nor amplify the provisions of this Contract Documents. The use herein of the word "including," when following any general statement, term, or matter, shall not be construed to limit such statement, term, or matter to the specific items or matters set forth immediately following such word or to similar items or matters, whether or not non-limiting language (such words as "without limitation," or "but not limited to," or words of similar import) is used with reference thereto, but rather shall be deemed to refer to all other items or matters that could reasonably fall within the broadest possible scope of such general statement, term, or matter.

§ 13.6.2 Wherever possible, each provision of the Contract Documents shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of the Contract Documents, or portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without in any manner invalidating or affecting the remaining provisions of the Contract Documents or valid portions of such provision, which are hereby deemed severable.

§ 13.6.3 Each party hereto agrees to do all acts and things and to make, execute and deliver such written instruments, as shall from time to time be reasonably required to carry out the terms and provisions of the Contract Documents.

§ 13.6.4 Any specific requirement in the Contract Documents that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and is also hereby deemed to include a Subcontractor or supplier of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor's responsibilities or obligations shall not be construed to diminish, abrogate, or limit any responsibilities or obligations of a Subcontractor or supplier of any tier under the Contract Documents or the applicable subcontract.

§ 13.6.5 The provisions of the Contract Documents shall not be changed, amended, waived, or otherwise modified in any respect except by a writing signed by the Owner. No person is authorized on behalf of the Owner to orally change, amend, waive, or otherwise modify the terms of the Contract Documents or any of the Contractor's duties or obligations under or arising out of the Contract Documents. Any change, waiver, approval, or consent granted to the Contractor shall be limited to the specific matters stated in the writing signed by Owner, and shall not relieve Contractor of any other of the duties and obligations under the Contract Documents. No "constructive" changes shall be allowed.

## ARTICLE 14 – TERMINATION OR SUSPENSION OF THE CONTRACT

### § 14.1 Termination by the Contractor

Add the following to Section 14.1:

In the event the Contractor wrongfully or mistakenly terminates the Contract under Sections 14.1.1 through 14.1.4, the Contractor may be declared by Owner to be in material breach of the Contract and the Contract Documents, and the Owner may exercise all rights and remedies provided in Section 14.2.

Replace Section 14.1.1, including subsections .1-.4, in their entirety as follows:

§ 14.1.1 The Contractor may terminate the Contract upon fourteen (14) days' written notice and opportunity to cure to the Owner and the Architect if the Work is stopped for a period of thirty (30) consecutive days through no act, omission, 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; or

.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in the Contract Documents, or because the Owner has not made payment on a Certificate for Payment within the time stated when required by the Contract Documents.

§ 14.1.2 The Contractor may terminate the Contract upon fourteen (14) days' written notice and opportunity to cure to the Owner and the Architect when, through no act, omission, 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 fourteen (14) days' written notice and opportunity to cure to the Owner and the Architect, terminate the Contract and recover from the Owner payment for Work properly executed, as well as reasonable overhead and profit on Work actually completed by the Contractor and accepted by the Owner, and out-of-pocket expenses incurred by reason of such termination, so long as the termination is authorized by the Contract Documents and the Contractor has minimized and mitigated its out-of-pocket expenses. In no event shall the Contractor be entitled to any additional compensation other than that set forth in this Section 14.1.3.

§ 14.1.4 If the Work is stopped for a period of sixty (60) consecutive days through no act, omission, 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 fourteen (14) additional days' written notice and opportunity to cure to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

Add the following new Section 14.2.5:

§ 14.2.5 If a termination pursuant to this Section 14.2 is subsequently determined by a jury, arbitrator or arbitration panel, or a court of competent jurisdiction to be wrongful, then such termination shall be converted automatically to a termination for convenience pursuant to Section 14.4, and the Contractor's remedies against the Owner shall be limited solely and exclusively to those remedies set forth in Section 14.4.

Replace Section 14.4.3 in its entirety as follows:

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed and actual Project costs incurred for such properly executed Work. No termination fee shall be paid, and the Contractor shall have no entitlement to lost profit on unperformed Work.

Add the following new Section 14.4.4:

§ 14.4.4 All obligations of the Contractor under the Contract with respect to completed Work, including, but not limited to, all warranties, guarantees, and indemnities, shall apply to all Work completed or substantially completed by the Contractor prior to a convenience termination by the Owner. Notwithstanding the above, any convenience termination by the Owner or payments to the Contractor shall be without prejudice to any claims or legal remedies that the Owner may have against the Contractor for any cause.

**ARTICLE 15 - CLAIMS AND DISPUTES**

**§ 15.4 Arbitration**

Delete Section 15.4 and all subsections in their entirety. Delete all references to Arbitration as a means for settling claims and disputes.

**END OF SUPPLEMENTARY GENERAL CONDITIONS**

**BID FORM**
PITT COUNTY
ADMINISTRATION BUILDING
Greenville. NC

Name of Bidder: _____
Address: _____
_____
_____
Contact: _____
Phone: _____
License No.: _____

The undersigned Bidder hereby certifies that this Bidder has visited the site of the work and has examined and fully comprehends the requirements and intent of the plans and specifications of the proposed work, and is familiar with all the conditions surrounding the construction of the project, including the availability of materials and labor. The undersigned Bidder hereby proposes and agrees, if this proposal is accepted, to furnish all labor, materials, supplies, plant, equipment, tools, apparatus, means of transportation, and other facilities necessary or proper for or incidental to the performance of the proposed **Pitt County Administration Building** as indicated on the Contract Documents to the entire satisfaction of Pitt County Government and JKF Architecture, PC., for the Total Lump Sum Base Bid of:

**GENERAL CONSTRUCTION CONTRACT (Single-Prime):**

Base Bid:

_____ Dollars ($ _____ )

List Subcontractors: _____ _____
Certified Mason: _____ License No. _____
Roofing Subcontractor: _____ License No. _____
Fire Protection Subcontractor: _____ License No. _____
Plumbing Subcontractor: _____ License No. _____
Mechanical Subcontractor: _____ License No. _____
Electrical Subcontractor: _____ License No. _____

Contractor shall complete all sections for Alternates and Unit Prices for Single-Prime Proposal.

The ***General*** contractor shall act as project expediter for all prime contracts. See Supplementary General Conditions.

**ALTERNATE BIDS (See Specification Section 012300 for complete description and time requirements)**

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid. (Strike out "Add" or "Deduct" as appropriate).

**Alternate Bid No. 1** – Alternate Landscaping:

Total Add/Deduct: _____ Dollars ($ _____ )

**Alternate Bid No. 2** – Preferred Alternate: Door Hardware: Corbin-Russwin:

Total Add/Deduct: _____ Dollars ($ _____ )

**UNIT PRICES (See Specification Section 012200 for complete description and time requirements)**

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents

**Unit Price No. 1**– Remove and replace unsuitable soils in building pad or parking areas.

Total: _____ Dollars ($ _____ per CY ).

**Unit Price No. 2**– Remove and replacement unsuitable soils in footings, foundations, and utility trenches.

Total: _____ Dollars ($ _____ per CY ).

**Unit Price No. 3** – Provide geotechnical fabric, geogrid, or other suitable stabilization material.

Total: _____ Dollars ($ _____ per SY).

**ALLOWANCES (See Specification Section 012100 for complete description and time requirements)**

Allowance quoted are included in the Base Bid amount and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

**Allowance No. 1:** Remove unsuitable soils.

Total: _____ Dollars ($ _____ ).

**Allowance No. 2:** Remove unsuitable soils (#57 Stone).

Total: _____ Dollars ($ _____ ).

This sum is to cover all expenses incurred in performing the work required under the Contract Documents, of which this proposal is a part and with the definite understanding of the undersigned Bidder that no money will be allowed for extra work except as set forth in the General Conditions of the Contract for Construction and Supplementary General Conditions of the Contract for Construction.

The above amount, and the amount(s) indicated for Alternates, if any, shall be shown in typing or written in ink in both words and figures. In case of discrepancy, the amount shown in words will govern.

The undersigned Bidder agrees that the prices quoted (including all labor, material, insurance, applicable taxes, equipment, overhead and profit) shall be the basis of compensation or deduction, as the case may be, for such increase or decrease in the work.

**RIGHT TO ACCEPT, WAIVE OR REJECT**

The undersigned Bidder understands that:

1. All parts of the Bid Form shall be completed by the Bidder for recognition as a bona fide bid.

2. The Owner reserves the right to accept (award) a Bid based upon a combination of cost, personnel to be assigned to this project, and past experience with the Owner (if any) regarding on schedule contract completion and response to any service required during warranty period(s).

3. The Owner reserves the right to waive informalities or irregularities in a Bid received and to reject any or all Bids.

**MODIFICATION OR WITHDRAWAL OF BIDS**

The undersigned Bidder agrees not to modify, withdraw or cancel the Bid for sixty (60) calendar days following the time and date designated for the receipt of Bids.

**TIME**

The undersigned Bidder agrees to commence work when directed by the Owner to proceed and to complete fully said General Construction and Associated Work to permit the work at the construction site to be complete within the following schedule after the date named in the order to proceed:

- Total contract duration will be 540 days. All days noted are consecutive calendar days.

The undersigned Bidder acknowledges that liquidated damage stipulations stated in the Supplementary General Conditions of the Contract for Construction, Article 8, are clearly understood.

**BID SECURITY**

The undersigned Bidder, in compliance with the Instructions to Bidders, Article 4, encloses with this Bid a Bid Security representing not less than 5% of the Base Bid amount in the form of a Certified Check ( ), or Bid Bond ( ) (check one) in the amount of:

_____ DOLLARS ($_____).

**PERFORMANCE-PAYMENT BOND**

The undersigned Bidder agrees, if awarded the Contract, to execute and deliver to the Owner satisfactory combined Performance Bond and Payment Bond in a sum equal to the full amount of the Contract and in compliance with the Instructions to Bidders, Article 7.

**E-VERIFY:**

Contractors, and the subcontractors they hire or engage, by submitting a Bid, certify they will comply with E-Verify requirements (or, if contractor/subcontractor employs less than 25 employees in this State, shall attest to that fact).

**PROPOSAL SIGNATURE PAGE**

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bond within ten (10) consecutive calendar days after written notice being given of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Attach certified check, cash or bid bond to this proposal.

Respectfully submitted this day of _____

_____

(Name of firm or corporation making bid)

WITNESS:

_____

(Proprietorship or Partnership)

By:_____

Signature

Name: _____

Print or type

Title_____

(Owner/Partner/Pres./V.Pres)

Address_____

_____

E-mail: _____

ATTEST:

By:_____

Title:_____

(Corp. Sec. or Asst. Sec. only)

License No._____

Federal I.D. No. _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____
Addendum No. 2 _____
Addendum No. 3_____
Addendum No. 4_____
Addendum No. 5 _____
Addendum No. 6 _____

# STATE OF NORTH CAROLINA
# COUNTY SALES AND USE TAX REPORT
# SUMMARY TOTALS AND CERTIFICATION

CONTRACTOR: _____ Page _____ of _____

PROJECT: _____ FOR PERIOD: _____

| | TOTAL FOR COUNTY OF: | TOTAL FOR COUNTY OF: | TOTAL FOR COUNTY OF: | TOTAL FOR COUNTY OF: | TOTAL FOR COUNTY OF: | TOTAL FOR COUNTY OF: | TOTAL ALL COUNTIES |
|---|---|---|---|---|---|---|---|
| CONTRACTOR | | | | | | | |
| SUBCONTRACTOR(S)* | | | | | | | |
| COUNTY TOTAL | | | | | | | |

* Attach subcontractor(s) report(s)
** Must balance with Detail Sheet(s)

I certify that the above figures do not include any tax paid on supplies, tools and equipment which were used to perform this contract and only includes those building materials, supplies, fixtures and equipment which actually became a part of or annexed to the building or structure. I certify that, to the best of my knowledge, the information provided here is true, correct, and complete.

Sworn to and subscribed before me,

This the _____ day of _____, 19____

_____
Signed

_____
Notary Public

_____
Print or Type Name of Above

My Commission Expires: _____

Seal

NOTE:
This certified statement may be subject to audit

STATE OF NORTH CAROLINA
SALES AND USE TAX REPORT DETAIL

CONTRACTOR: _____ Page _____ of _____

SUBCONTRACTOR _____ FOR PERIOD: _____

PROJECT: _____

| PURCHASE DATE | VENDOR NAME | INVOICE NUMBER | TYPE OF PROPERTY | INVOICE TOTAL | COUNTY TAX PAID | COUNTY OF SALE * |
|---|---|---|---|---|---|---|
| | | | | $ | $ | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | TOTAL: | $ | |

* If this is an out-of-state vendor, the County of Sale should be the county to which the merchandise was shipped.

# Pitt County New Administration Building

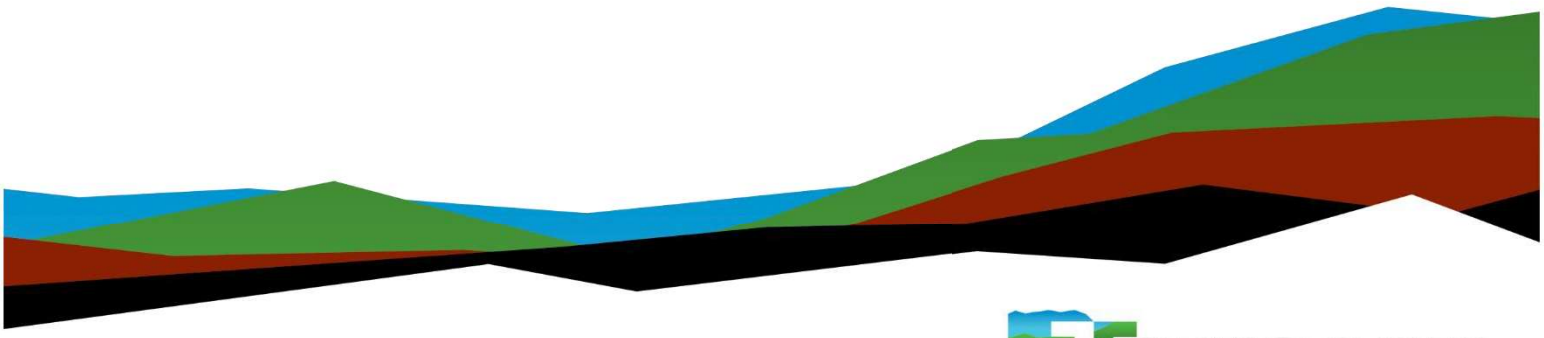
## Geotechnical Engineering Report

Greenville, North Carolina

November 17, 2025 | Terracon Project No. 72255088

**Prepared for:**

Pitt County Engineering Dept
1717 W 5th St
Greenville, North Carolina 27834



Terracon
Explore with us

Nationwide
Terracon.com

- Facilities
- Environmental
- Geotechnical
- Materials

314 Beacon Drive
Winterville, NC 28590
P (252) 353-1600
North Carolina Registered Firm: F-0869
**Terracon.com**

November 17, 2025

Pitt County Engineering Dept
1717 W 5th St
Wilson, NC 27893

Attn: Mr. Tim Corley, P.E. / County Engineer
P: (252) 902-3175
E: Tim.Corley@pittcountync.gov

Re: Geotechnical Engineering Report
Pitt County New Administration Building
Intersection of Health Drive and Government Circle
Greenville, North Carolina
Terracon Project No. 72255088

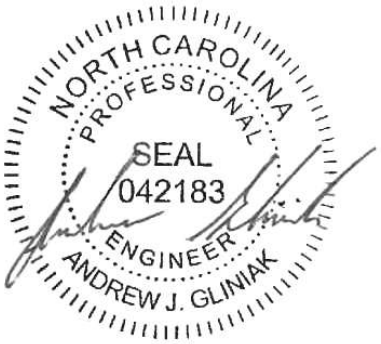
Dear Mr. Corley:

We have completed the scope of Geotechnical Engineering services for the above-referenced project in general accordance with Terracon Proposal No. P70255088 dated October 20, 2025. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, the design and construction of foundations, and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

**Terracon**




Thomas A. Scrivner
Thomas A. Scrivner
Geotechnical Staff

Andrew J. Gliniak, P.E.
Project Engineer
Registered, NC 042183

# Table of Contents

**Report Summary** ..... i
**Introduction** ..... 1
**Project Description** ..... 1
**Site Conditions** ..... 2
**Geotechnical Characterization** ..... 3
**Seismic Site Class** ..... 4
**Geotechnical Overview** ..... 5
**Shallow Foundations** ..... 11
**Floor Slabs** ..... 13
**General Comments** ..... 18

## Figures

GeoModel

## Attachments

**Exploration and Testing Procedures**
**Photography Log**
**Site Location and Exploration Plans**
**Exploration and Laboratory Results**
**Supporting Information**

**Note:** This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

# Report Summary

| Topic [1] | Overview Statement [2] |
|---|---|
| **Project Description** | The project will consist of a two-story office administration building with a surrounding parking lot. |
| **Geotechnical Characterization** | The exploration encountered very loose to medium dense sand. Groundwater is anticipated at depths ranging from 2 feet to 13 feet beneath existing site grades. |
| **Earthwork** | Our recommendations include rolling the entire subgrade, raising existing grade approximately 1 foot, and earthwork operations should be performed during the warmer, drier periods of the year (May through October) to avoid problems associated with a wet subgrade.<br>Further details are provided in **Earthwork**. |
| **Shallow Foundations** | With subgrade prepared as noted in **Earthwork**.<br>Allowable bearing pressure = 2,000 psf<br>Expected settlements: < 1-inch total, < 1/2-inch differential |
| **Pavements** | With subgrade prepared as noted in **Earthwork**.<br>Concrete:<br>■ 5 inches Portland Cement Concrete (PCC) in Light Duty and Medium Duty areas<br>■ 7 inches PCC over 4 inches ABC in Heavy Duty areas<br>Asphalt:<br>■ 3 inches Asphaltic Concrete (AC) over 6 inches ABC in Light Duty areas<br>■ 4 inches AC over 8 inches ABC in Medium Duty areas |
| **General Comments** | This section contains important information about the limitations of this geotechnical engineering report. |

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

# Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Trinity Methodist Church Sanctuary addition to be located on Intersection of Health Drive and Government Circle in Greenville, North Carolina. The purpose of these services was to provide the following information and recommendations:

- Site Location and Exploration Plans
- Subsurface exploration procedures
- Exploration logs with field and laboratory data
- Stratification based on visual soil classification
- Groundwater levels observed during and after the completion of drilling
- Recommended foundation options and engineering design parameters
- Estimated settlement of foundations
- Recommendations for design and construction of interior floor slabs
- Seismic site classification
- Earthwork recommendations including site/subgrade preparation
- Recommended pavement options and design parameters

The geotechnical engineering Scope of Services for this project included advancement of borings, Standard Penetration Testing (SPT) soil sampling, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and exploration locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included in the **Exploration and Laboratory Results** section.

# Project Description

Our understanding of the project is as follows.

| Item | Description |
|---|---|
| **Information Provided** | Project information was emailed to Terracon by JKF Architecture PC on October 16, 2025. Project information included plans for a new administrative building and requested boring locations. |

| Item | Description |
|---|---|
| **Project Description** | The project includes a two-story administration building approximately 38,000 square feet and approximately 320 parking spaces. |
| **Building Construction** | Wood frame<br>Slab-on-grade |
| **Finished Floor Elevation** | Unknown, assumed to match existing grade. |
| **Maximum Loads** | Anticipated structural loads were not provided. We will use the following loads in estimating settlement based on our experience.<br>▪ Columns: 50 kips<br>▪ Walls: 3 kips per linear foot (klf)<br>▪ Slabs: Less than 100 pounds per square foot (psf) |
| **Grading/Slopes** | Approximately 1 foot of cut and 2 feet of fill is assumed to develop final grade, excluding remedial grading requirements. |
| **Retaining Wall** | No retaining wall has been proposed at this time. |
| **Stormwater Management** | None. Scope of work did not include stormwater management area. |
| **Pavements** | Anticipated traffic is as follows:<br>▪ Autos/light trucks: 1,000 vehicles per day<br>▪ Light delivery and trash collection vehicles: <20 vehicles per week<br>▪ Tractor-trailer trucks: <1 vehicles per week<br>The pavement design period is 20 years. |
| **Building Code** | 2024 North Carolina State Building Code |

Terracon should be notified if any of the above information is inconsistent with the planned construction, as modifications to our recommendations may be necessary.

# Site Conditions

The following description of site conditions is derived from information provided to us, our site visit(s) and our review of publicly available information.

| Item | Description |
|---|---|
| **Parcel Information** | The project will be located at Intersection of Health Drive and Government Circle in Greenville, North Carolina.<br>Latitude/Longitude (approximate) 35.6393°, -77.3624°<br>(See **Site Location**) |
| **Existing Improvements** | The site is undeveloped except for tree landscaping. |
| **Current Ground Cover** | Grass. |
| **Existing Topography** | Based on information interpolated from provided site plans, the ground elevation is 109 feet across the whole site. |

We also collected photographs at the time of our field exploration program. Representative photos are provided in our **Photography Log**.

# Geotechnical Characterization

## Geology

The project site is located in the Coastal Plain Physiographic Province. The Coastal Plain soils consist mainly of marine sediments that were deposited during successive periods of fluctuating sea level and moving shoreline. The soils include sands, silts, and clays with irregular deposits of shells, which are typical of those lain down in a shallow sloping sea bottom. Recent alluvial sands, silts, and clays are typically present near rivers and creeks.

According to USGS Mineral Resources On-Line Spatial Data based on the 1998 digital equivalent of the 1985 Geologic Map of North Carolina, the site is mapped within the Surficial Deposits, Undivided (Tertiary).

## Soil Conditions

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration and Laboratory Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each test location, refer to

the GeoModel. Surficial materials are not included in the GeoModel and do not delineate these materials.

| Model Layer | Layer Name | General Description |
|---|---|---|
| **1** | **Sand** | Very loose to medium dense sand with trace amounts of silt and clay |
| **2** | **Clay** | Very soft clay |

The topsoil thickness encountered at the test locations varied from approximately 2 inches to 5 inches.

### Groundwater Conditions

Mud rotary drilling techniques were used to advance some of the borings which can obscure the detection of water levels. Groundwater was estimated at depths between 2 feet to 13 feet below the existing ground surface while drilling and at depths of 8 feet to 10 feet at the completion of drilling. Based on the measured water depths and moisture content of the soil samples, groundwater is anticipated at depths of 10 feet to 13 feet.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the exploration logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

## Seismic Site Class

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7-16 and the 2024 North Carolina Building Code. Based on the soil properties observed at the site and as described on the exploration logs and results, our professional opinion is that a **Seismic Site Classification of D** be considered for the project. Subsurface explorations at this site were extended to a maximum depth of 25 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area.

# Liquefaction

Based on the results of the borings and soundings, liquefaction is not expected after the recommended earthwork and relatively low level of ground motions associated with the design earthquake.

# Geotechnical Overview

Based upon the geotechnical conditions encountered in our exploration, the site can be improved for the proposed construction, provided that the recommendations given herein are implemented in the design and construction phases of this project. Our recommendations include rolling the subgrade, remediation of soils that are not improved during earthwork. Isolated foundation undercut to remove relatively looser soil to depths up to 4 feet below existing site grades, such as encountered at test locations B-04 could be required.

Performing earthwork operations during warmer periods of the year (May through October) will reduce the potential for problems associated with wet, unstable subgrades. Positive site drainage is essential to aid in maintaining stable subgrade conditions. Laboratory testing of near-surface soils samples revealed natural moisture content that is expected to be higher than the soil Plastic Limit, which suggests instability of the subgrade soils should be anticipated. For this reason, low ground pressure/tracked equipment should be anticipated for site preparation. Raising site grades on the order of 1 foot would also help improve subgrade conditions

Following the recommended **Earthwork**, the structure can be supported on **Shallow Foundations**. The **Floor Slabs** section addresses slab-on-grade support of the building.

A rigid pavement system is suitable for this site. The **Pavements** section addresses the design of pavement systems supported on the densified existing soils or structural fill.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

# Earthwork

Earthwork is anticipated to include demolition and excavation. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs,

and pavements. Grading for the structure should incorporate the limits of the proposed structure plus 5 feet beyond proposed perimeter building walls and any exterior columns. This minimum could be widened for construction or future maintenance as required.

## Site Preparation

Prior to placing fill, existing vegetation, topsoil, and root mats should be removed. Complete stripping of the topsoil should be performed in the proposed building areas. Performing earthwork operations during warmer periods of the year (May through October) will reduce the potential for problems associated with wet, unstable subgrades.

## Subgrade Preparation

After stripping and removing topsoil and once any areas of cut have been excavated to proposed subgrade elevation, the exposed subgrade soils in the building and pavement footprints should be densified in place using a medium weight vibratory roller. The purpose of the vibratory rolling is to densify the exposed subgrade soils for floor slab and pavement support and to potentially improve the foundation bearing soils. The roller should make at least six passes across the site, with the second set of three passes perpendicular to the first set of three passes with intermittent vibration activated**. If water is brought to the surface by the vibratory rolling, the operation should be discontinued until the water subsides.** Vibratory rolling should be completed during dry weather. Static rolling and additional repairs should be anticipated for areas too wet for vibratory rolling.

After the vibratory rolling, pore pressures should be allowed to dissipate for a minimum of 16 hours. After the waiting period, proof-rolling should be performed on the exposed subgrade soils in areas to receive fill or at the subgrade elevation with an empty tandem-axle dump truck or similar rubber-tired construction equipment. Proof-rolling prior to slab or pavement construction after placing fill to design grades should be completed with a loaded, tandem-axle dump truck (15-ton to 20-ton total vehicle weight) or similar rubber-tired construction equipment. Proof-rolling is recommended as a means of detecting areas of soft or unstable subgrade soils. The proof-rolling should be performed during a period of dry weather to avoid degrading an otherwise suitable subgrade. The proof-rolling operations should be observed by a representative of the geotechnical engineer. Subgrade soils that exhibit excessive rutting or deflection during proof-rolling should be repaired as directed by the field representative. Typical repairs include overexcavation followed by replacement with either properly compacted fill or by a subgrade stabilization fabric in conjunction with a sand fill or crushed stone.

If subgrade soils are unsuitable, they will require removal and replacement; however, if they are unstable due to excessive moisture, an economical solution for remediation may be to scarify, dry and recompact the material. This remediation is most effective during the typically hotter months of the year (May to October). If construction is

performed during the cooler period of the year, the timeline for scarifying, drying, and recompacting typically increases considerably and may lead to alternative remediation solutions. These solutions can include overexcavation of some or all of the unstable material to be backfilled with either approved structural fill or geotextile and ABC Stone. Potential undercutting can be reduced if the site preparation work is performed during a period of dry weather and if construction traffic is kept to a minimum on prepared subgrades. We recommend that the contractor submit a unit rate cost for undercutting as part of the bidding process.

## Excavation

We anticipate that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or continued construction.

## Fill Material Types

Fill (engineered fill) required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 5 feet of structures and pavements. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural fill should meet the following material property requirements:

| Soil Type[1] | USCS Classification | Acceptable Location for Placement |
|---|---|---|
| Imported Soil | SC, SM, SP | All locations and elevations |
| On-Site Soils | SC, SM, SC-SM | All locations and elevations |

1. Structural fill should consist of approved materials free of organic matter and debris. Frozen materials should not be used, and fill should not be placed on frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Fine-grained soils such as clays and silts should not be reused as structural fill due to their moisture sensitivity when compared to the sandier soils available. Reuse of on-site SM or SC material will likely lead to delays in construction based on laboratory testing of their moisture condition.

## Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

| Item | Structural Fill | General Fill |
|---|---|---|
| **Maximum Lift Thickness** | 9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used<br>4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used | Same as structural fill |
| **Minimum Compaction Requirements** [1,2,3] | 95% of maximum<br>98% of maximum within 1 foot of pavement subgrade | 92% of max. |
| **Water Content Range** [1, 3] | Within 2 percent of optimum moisture content | As required to achieve min. compaction requirements |

1. Fill should be tested for moisture content and compaction during placement. If in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the tests should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. It is not necessary to achieve 95% compaction on the existing ground prior to placing fill or beginning construction. However, the subgrade should be evaluated by the Geotechnical Engineer prior to placing fill or beginning construction.
3. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
4. Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer.

## Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility being supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the material requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

## Grading and Drainage

All grades must provide effective drainage away from the buildings during and after construction and should be maintained throughout the life of the structure. Water retained next to the buildings can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 5 feet from the buildings.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 5 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

## Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Earthwork operations should be performed during the warmer, drier periods of the year (May through October) to avoid problems associated with a wet subgrade.

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

The groundwater table could affect overexcavation efforts, especially for overexcavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps may be necessary to achieve the recommended depth of overexcavation depending on groundwater conditions at the time of construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

## Construction Observation and Testing

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proofrolling, placement and compaction of structural fill, backfilling of excavations, and just prior to construction of building floor slabs and pavements.

The earthwork efforts should be observed by the Geotechnical Engineer (Terracon). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, cultivated soil), as well as proofrolling and mitigation of unsuitable areas delineated by the proofrolling.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. Where not specified by local ordinance, one density and water content test should be performed for every 50 linear feet of compacted utility trench

backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

# Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

## Design Parameters – Compressive Loads

| Item | Description |
|---|---|
| **Maximum Net Allowable Bearing Pressure** [1, 2] | 2,000 psf |
| **Required Bearing Stratum** [3] | Approved existing soils or structural fill |
| **Minimum Foundation Dimensions** | Columns: 24 inches<br>Continuous: 16 inches<br>Thickened: 12 inches |
| **Sliding Resistance** [4] | 0.35 ultimate coefficient of friction |
| **Minimum Embedment below Finished Grade** [5] | 12 inches |
| **Estimated Total Settlement from Structural Loads** [2] | Less than approximately 1 inch |
| **Estimated Differential Settlement** [2, 6] | Up to 1/2 of total settlement |

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure. The maximum net allowable bearing pressure may be increased by 1/3 for transient wind loads and seismic loads.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing

| Item | Description |
|---|---|

pressure which may vary due to load combinations. For fine-grained materials, lateral resistance using cohesion should not exceed ½ the dead load.

5. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
6. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

## Design Parameters – Overturning and Uplift Loads

Shallow foundations subjected to overturning loads should be proportioned such that the resultant eccentricity is maintained in the center-third of the foundation (e.g., e < b/6, where b is the foundation width). This requirement is intended to keep the entire foundation area in compression during the extreme lateral/overturning load event. Foundation oversizing may be required to satisfy this condition.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils with consideration to the NCBC basic load combinations.

| Item | Description |
|---|---|
| **Soil Moist Unit Weight** | 120 pcf |
| **Soil Effective Unit Weight**[1] | 48 pcf |
| **Soil weight included in uplift resistance** | Soil included within the prism extending up from the top perimeter of the footing at an angle of 20 degrees from vertical to ground surface |

1. Effective (or buoyant) unit weight should be used for soil above the foundation level and below a water level. The high groundwater level should be used in uplift design as applicable.

## Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the observation of the Geotechnical Engineer. This is an essential part of the construction process. The Geotechnical Engineer should use a combination of hand auger borings and dynamic cone penetrometer (DCP) testing to determine the suitability of the bearing materials for the design bearing pressure. DCP testing should be performed to a depth of 3 feet to 5 feet below the bottom of foundation excavation and through any existing fill soils. Excessively soft, loose, or wet bearing soils should be over excavated to a depth recommended by the geotechnical engineer. The excavated soils should be replaced with structural fill or washed, crushed stone (NCDOT No. 57) wrapped in a geotextile fabric

(Mirafi 140 N or equivalent). The need for the geotextile fabric with the crushed stone should be determined by the Geotechnical Engineer during construction based on sloughing/caving soils and excavation observations. However, footings could bear directly on the soils after over excavation if approved by the Geotechnical Engineer.

The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively disturbed or saturated, the affected soil should be removed prior to placing concrete.

# Floor Slabs

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the building(s). Connecting corridors such as doorways and walkways to the additions should be dowelled to the existing adjacent slab to help reduce differential settlement.

## Floor Slab Design Parameters

| Item | Description |
|---|---|
| **Floor Slab Support**[1] | Suitable existing soils or new structural fill compacted in accordance with **Earthwork** section of this report. |
| **Estimated Modulus of Subgrade Reaction**[2] | 100 pounds per square inch per inch (psi/in) for point loads |
| **Aggregate base course/capillary break**[3] | Minimum 4 inches of free-draining granular material (less than 5% passing the U.S. No. 200 sieve) such as NCDOT No. 57 stone. |

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3. Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support

equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

## Floor Slab Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of base course and concrete, and corrective action will be required to repair the damaged areas.

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab base course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

# Pavements

## General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

## Pavement Design Parameters

A California Bearing Ratio (CBR) of 5 was selected for design based upon our experience with similar near surface subgrade soils and our understanding of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**. A minimum pavement section thickness was also included in the design for future maintenance.

## Pavement Section Thicknesses

The following table provides our opinion of minimum thickness for AC sections:

**Asphaltic Concrete Design**

| Layer | Thickness (inches) | | |
|---|---|---|---|
| | NCDOT Grading [1] | Automobile Areas (Light Duty) | Main Drives and Truck Access Areas (Medium Duty) |
| AC Surface | S-9.5B | 3 [2] | 1.5 |
| AC Intermediate | I-19.0C | -- | 2.5 |
| Aggregate Base | ABC | 6 | 8 |

1. All materials should meet the current North Carolina Department of Transportation Standard Specifications
2. Placed in two equal lifts.
3. See **Project Description** for more specifics regarding traffic assumptions.

The following table provides our estimated minimum thickness of PCC pavements.

**Portland Cement Concrete Design**

| Layer | Specification [1] | Thickness (inches) | | |
|---|---|---|---|---|
| | | Automobile Areas (Light Duty) | Main Drives and Truck Access Areas (Medium Duty) | Heavy Duty [2] |
| PCC | 4,000 psi | 5 | | 7 |
| Aggregate Base | ABC [3] | 4 | | 4 |

1. All materials should meet the current North Carolina Department of Transportation (NCDOT) Standard Specifications.
2. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g. dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles.
3. Crushed Aggregate Base Course is recommended for construction purposes. Concrete could be placed directly on an approved subgrade. However, stormwater can quickly degrade exposed subgrades without the crushed aggregate base course leading to additional subgrade repair.
4. See **Project Description** for more specifics regarding traffic assumptions.

For subgrade instability that could develop due to the weather, we recommend that contingencies be placed in the budget for stabilization of the subgrade in planned pavement areas using a geosynthetic fabric or geogrid and additional ABC stone. The geosynthetic or geogrid could be left off corridors/easements for deeper utility lines for ease of construction.

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles.

Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer. PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330 and ACI 325.

Where practical, we recommend early-entry cutting of crack-control joints in PCC pavements. Cutting of the concrete in its "green" state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. Islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils are particular areas of concern. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the stormwater collection system, longitudinal subdrains, or other suitable outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

The placement of a partial pavement thickness for use during construction is not suggested without a detailed pavement analysis incorporating construction traffic. If the actual traffic varies from the assumptions outlined in **Project Description** we should be contacted to update our recommendations as necessary.

## Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted backfill against the exterior side of curb and gutter.

- Place curb, gutter and/or sidewalk directly on compacted subgrade soils rather than on unbound granular base course materials

# General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on

nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

# Figures

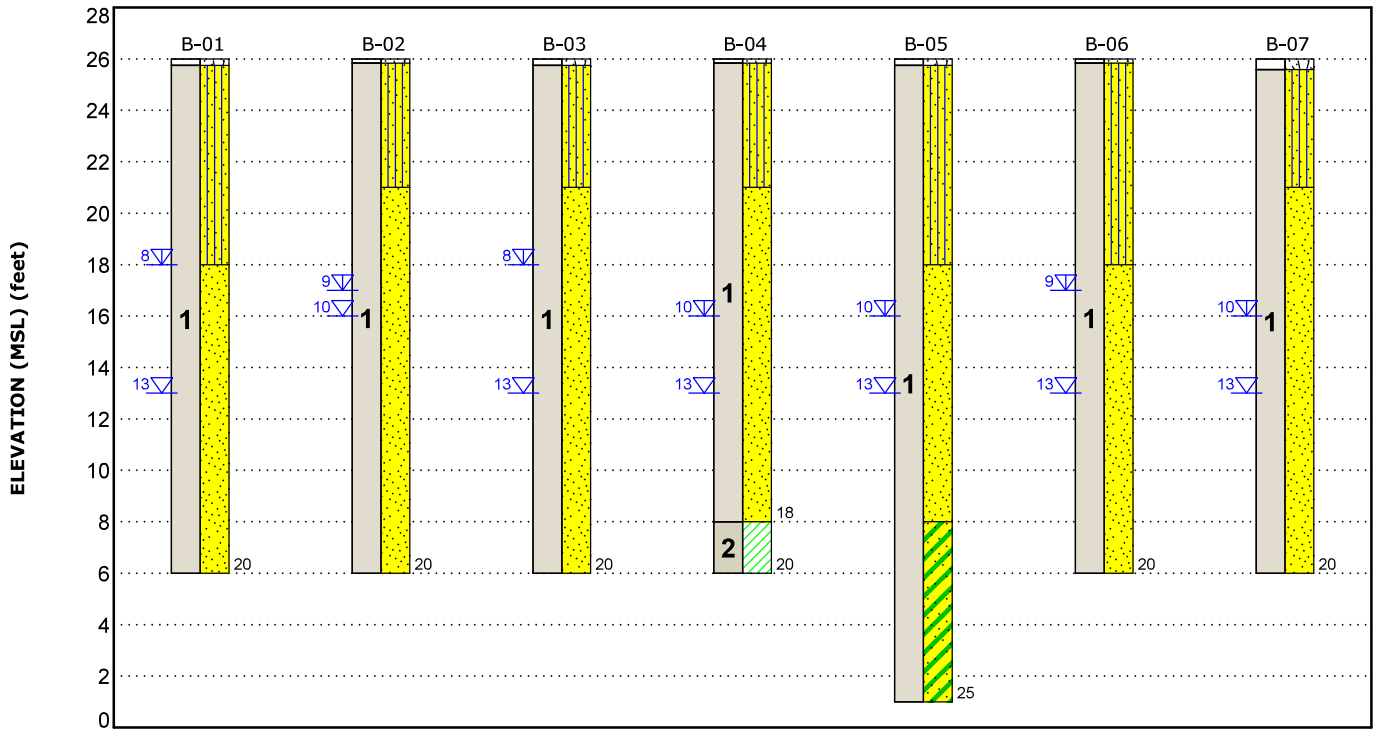
**Contents:**

GeoModel (two pages)

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# GeoModel




This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

| Model Layer | Layer Name | General Description |
|---|---|---|
| 1 | Sand | Very loose to medium dense sand with trace amounts of silt and clay |
| 2 | Clay | Very soft clay |

**Legend**

Topsoil
Silty Sand
Poorly-graded Sand
Lean Clay
Clayey Sand

▽ First Water Observation
▽ Second Water Observation

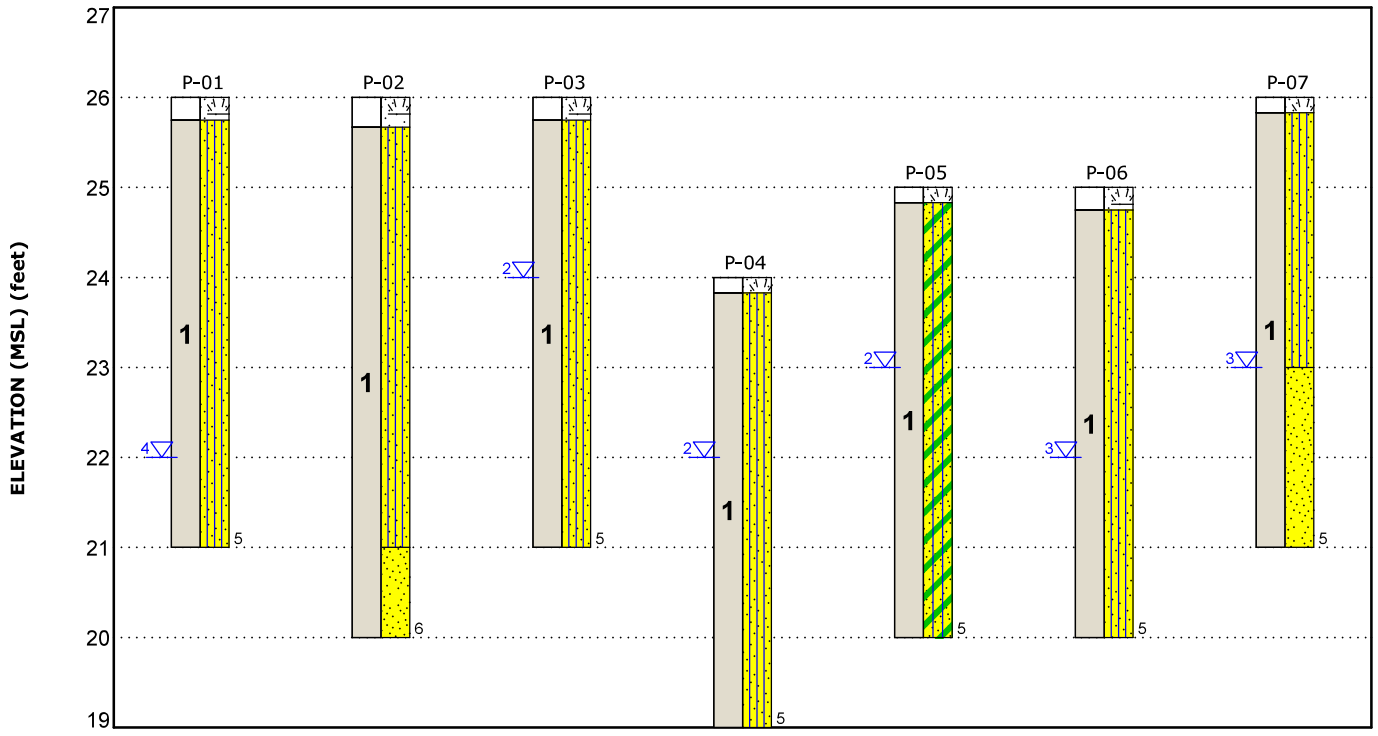
Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# GeoModel




This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

| Model Layer | Layer Name | General Description |
|---|---|---|
| 1 | Sand | Very loose to medium dense sand with trace amounts of silt and clay |
| 2 | Clay | Very soft clay |

**Legend**

Topsoil
Silty Sand
Poorly-graded Sand
Silty Clayey Sand

▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

# Attachments

# Exploration and Testing Procedures

## Field Exploration

| Number of Tests | Approximate Testing Depth (feet) [1] | Location |
|---|---|---|
| 7 (B-01 through B-07) | 20 to 25 | Building test location |
| 7 (P-01 through P-07) | 5 | Pavement test location |

1. Referenced from existing ground surface.

**Exploration Layout and Elevations:** Terracon personnel provided the exploration layout using handheld GPS equipment (estimated horizontal accuracy of about ±15 feet) and referencing existing site features. Approximate ground surface elevations were estimated using Google Earth Pro™.

**Subsurface Exploration Procedures:** We advanced the SPT borings with mud rotary drilling procedures. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon 6 inches to 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. For safety purposes, all borings were backfilled with bentonite and soil cuttings after their completion.

We observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. The attached boring logs provide groundwater information, including groundwater depths.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our geotechnical laboratory for testing and classification by geotechnical staff. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

## Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Grain-Size Analysis
- Atterberg Limits

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

# Photography Log

Photographs taken October 23, 2025.



View of the site facing north from B-02.



View of the site facing east from B-07.



View of the site facing south from B-06.



View of the site facing west from B-03.

# Site Location and Exploration Plans

**Contents:**

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

## Site Location

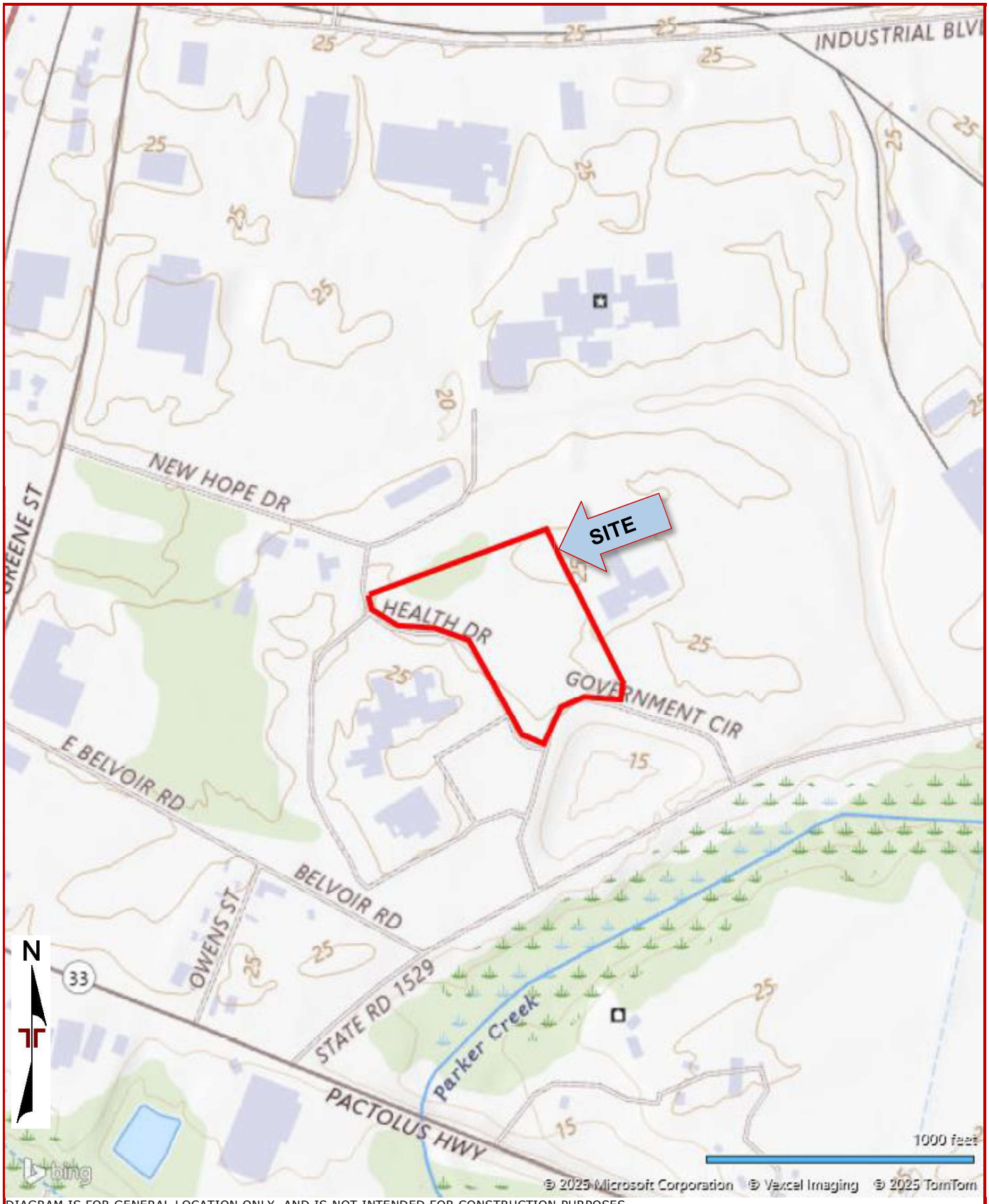



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES
MAP PROVIDED BY USGS, 2025

## Exhibit E – Exploration Plan

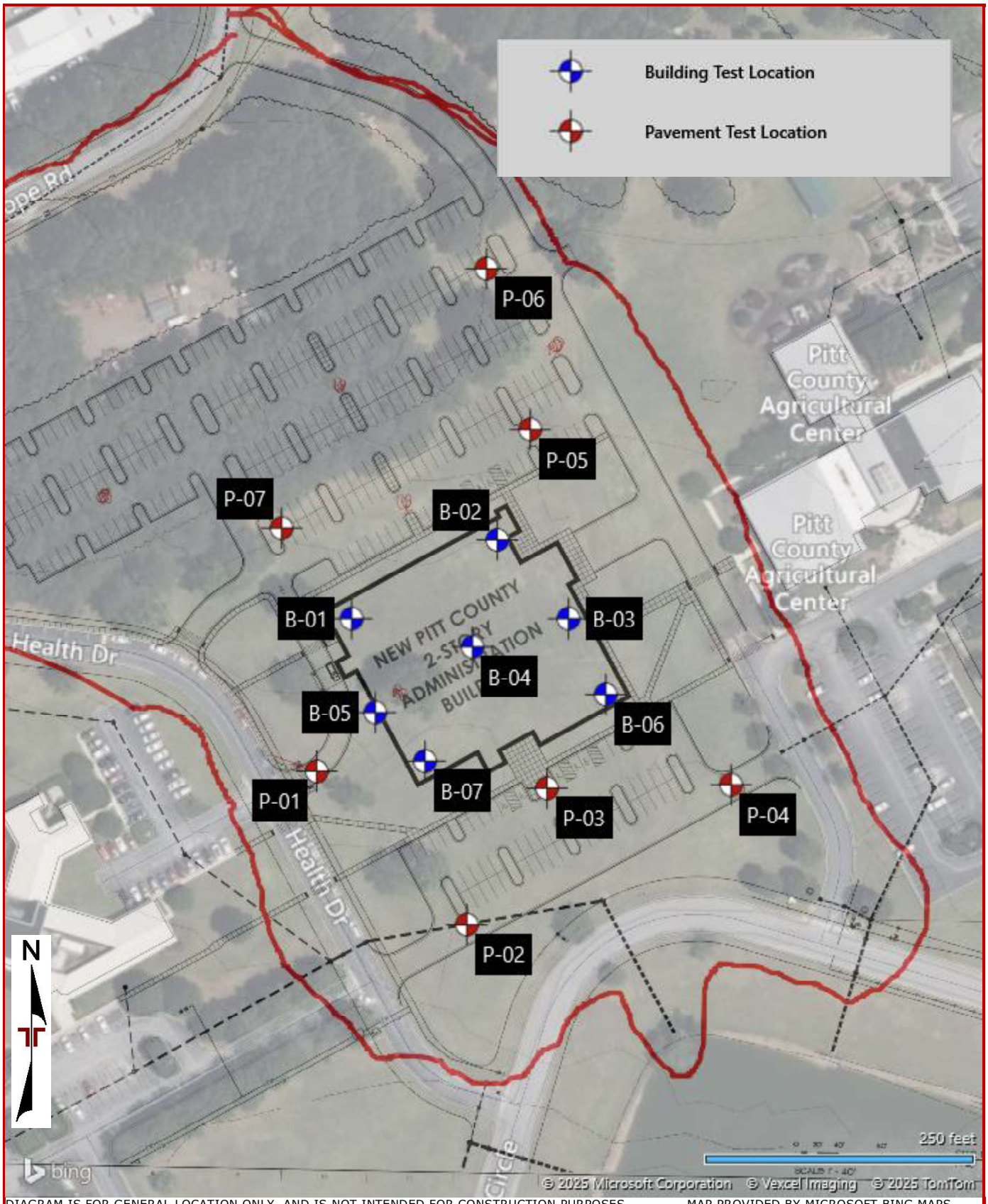



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES
SITE PLAN PROVIDED BY CLIENT

MAP PROVIDED BY MICROSOFT BING MAPS

# Exploration and Laboratory Results

**Contents:**

Boring Logs (B-01 through B-07 and P-01 through P-07)
Atterberg Limits
Grain Size Distribution

Note: All attachments are one page unless noted above.

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. B-01

Location: See Exploration Plan

Latitude: 35.6392° Longitude: -77.3624°

Depth (Ft.) Approximate Elevation: 26 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.3 **TOPSOIL**, 3 inches (25.75) | | | | | | |
| | | **SILTY SAND (SM)**, brown to tan, medium dense, trace organics | | | 4-4-6 N=10 | | | |
| | | | | | 4-5-5 N=10 | | | |
| | | 5 | | | 5-5-6 N=11 | | | |
| | | 8.0 (18) | | | | | | |
| | | **POORLY GRADED SAND (SP)**, tan to gray, very loose to medium dense, trace clay | | | 4-4-4 N=8 | | | |
| | | 10 | | | | | | |
| | | | | | 8-8-8 N=16 | | | |
| | | 15 | | | | | | |
| | | 20.0 (6) | | | 1-1-1 N=2 | | | |
| | | 20 | | | | | | |
| | | ***Boring Terminated at 20 Feet*** | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
While drilling
At completion of drilling
Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
11-03-2025

**Boring Completed**
11-03-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. B-02

Location: See Exploration Plan

Latitude: 35.6394° Longitude: -77.3620°

Depth (Ft.) Approximate Elevation: 26 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.2 **TOPSOIL**, 2 inches (25.83) | | | | | | |
| | | **SILTY SAND (SM)**, brown, loose | | | 2-2-2 N=4 | | | |
| | | | | | 1-2-2 N=4 | 17.7 | | |
| | | 5.0 (21) | | | | | | |
| | | **POORLY GRADED SAND (SP)**, orange to brown to gray, medium dense | | | 4-7-8 N=15 | | | |
| | | | ▽ | | 6-6-5 N=11 | | | |
| | | | ▽ | | | | | |
| | | | ▨ | | | | | |
| | | | | | 4-5-6 N=11 | | | |
| | | 20.0 (6) | | | 5-5-7 N=12 | | | |
| | | ***Boring Terminated at 20 Feet*** | | | | | | |

5 10 15 20

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
▽ While drilling
▽ At completion of drilling
▨ Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
11-03-2025

**Boring Completed**
11-03-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. B-03

Location: See Exploration Plan

Latitude: 35.6392° Longitude: -77.3617°

Depth (Ft.) Approximate Elevation: 26 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.3 **TOPSOIL**, 3 inches (25.75) | | | | | | |
| | | **SILTY SAND (SM)**, brown and orange, loose to medium dense | | | 4-3-3 N=6 | | | |
| | | | | | 3-4-6 N=10 | | | |
| | | 5.0 (21) | | | | | | |
| | | **POORLY GRADED SAND (SP)**, orange to dark gray, loose to medium dense | | | 3-5-5 N=10 | | | |
| | | | ▽ | | 4-5-7 N=12 | | | |
| | | | ▽ | | 5-6-4 N=10 | | | |
| | | 20.0 (6) | | | 4-2-2 N=4 | | | |
| | | ***Boring Terminated at 20 Feet*** | | | | | | |

5 10 15 20

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
▽ While drilling
▽ At completion of drilling
Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
11-04-2025

**Boring Completed**
11-04-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. B-04

Location: See Exploration Plan

Latitude: 35.6392° Longitude: -77.3617°

Depth (Ft.) Approximate Elevation: 26 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.2 **TOPSOIL**, 2 inches (25.8) | | | | | | |
| | | **SILTY SAND (SM)**, dark brown to brown, very loose to loose, trace organics | | | | | | |
| | | | | | 2-1-2 N=3 | 13.9 | | |
| | | | | | 2-2-3 N=5 | | | |
| | | 5.0 (21) | | | | | | |
| | | **POORLY GRADED SAND (SP)**, orange, medium dense | | | | | | |
| | | 5 | | | | | | |
| | | | | | 4-4-7 N=11 | | | |
| | | | | | 4-5-5 N=10 | | | |
| | | 10 | ▽ | | | | | |
| | | | ▨ | | | | | |
| | | | ▽ | | | | | |
| | | | | | 3-5-5 N=10 | 19.4 | | 1.8 |
| | | 15 | | | | | | |
| 2 | | 18.0 (8) **LEAN CLAY (CL)**, dark gray, very soft | | | | | | |
| | | 20.0 (6) | | | WOH | | | |
| | | 20 | | | | | | |
| | | ***Boring Terminated at 20 Feet*** | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
▽ While drilling
▽ At completion of drilling
▨ Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
11-04-2025

**Boring Completed**
11-04-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. B-05

Location: See Exploration Plan

Latitude: 35.6391° Longitude: -77.3620°

Depth (Ft.) Approximate Elevation: 26 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.3 **TOPSOIL**, 3 inches (25.75) | | | | | | |
| | | **SILTY SAND (SM)**, brown to orange, loose to medium dense, trace organics | | | 1-1-6 N=7 | | | |
| | | | | | 4-6-7 N=13 | | | |
| | | | | | 4-5-6 N=11 | | | |
| | | 8.0 (18) | | | 5-5-5 N=10 | | | |
| | | **POORLY GRADED SAND (SP)**, orange to gray, very loose to medium dense | ▽ | | | | | |
| | | | ▽ | | 3-4-4 N=8 | | | |
| | | 18.0 (8) | | | | | | |
| | | **CLAYEY SAND (SC)**, dark gray, very loose | | | WOH-1-1 N = 2 | 24.6 | 23-11-12 | 48.7 |
| | | 25.0 (1) | | | 1-2-1 N=3 | | | |
| | | ***Boring Terminated at 25 Feet*** | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
▽ While drilling
▽ At completion of drilling
Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Logged by**
TAS

**Boring Started**
11-03-2025

**Boring Completed**
11-03-2025

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. B-06

Location: See Exploration Plan

Latitude: 35.6390° Longitude: -77.3632°

Depth (Ft.) Approximate Elevation: 26 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.2 **TOPSOIL**, 2 inches (25.83) | | | | | | |
| | | **SILTY SAND (SM)**, brown to orange, loose to medium dense, trace organics | | | 3-4-5 N=9 | | | |
| | | | | | 1-2-2 N=4 | | | |
| | | | | | 5-6-6 N=12 | | | |
| | | 8.0 (18) | | | | | | |
| | | **POORLY GRADED SAND (SP)**, orange to dark gray, loose to medium dense | | | 5-5-6 N=11 | | | |
| | | | | | 4-4-2 N=6 | | | |
| | | 20.0 (6) | | | 4-3-4 N=7 | | | |
| | | ***Boring Terminated at 20 Feet*** | | | | | | |

5 10 15 20

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
While drilling
At completion of drilling
Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
11-04-2025

**Boring Completed**
11-04-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. B-07

Location: See Exploration Plan

Latitude: 35.6388° Longitude: -77.3622°

Depth (Ft.) Approximate Elevation: 26 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| | | 0.4 **TOPSOIL**, 5 inches (25.58) | | | | | | |
| 1 | | **SILTY SAND (SM)**, brown, loose | | | 4-4-5 N=9 | | | |
| | | 5.0 (21) | | | 1-2-3 N=5 | | | |
| | | **POORLY GRADED SAND (SP)**, orange to tan, loose to medium dense | | | 4-6-7 N=13 | | | |
| | | | | | 3-5-6 N=11 | | | |
| | | | | | 2-4-6 N=10 | | | |
| | | 20.0 (6) | | | 2-5-4 N=9 | | | |
| | | ***Boring Terminated at 20 Feet*** | | | | | | |

5 10 15 20

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
While drilling
At completion of drilling
Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
10-29-2025

**Boring Completed**
10-29-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. P-01

| Model Layer | Graphic Log | Location: See Exploration Plan<br>Latitude: 35.6388° Longitude: -77.3625°<br>Depth (Ft.) — Approximate Elevation: 26 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.3 **TOPSOIL**, 3 inches (25.75)<br>**SILTY SAND (SM)**, brown, loose, trace organics | | | | 3-4-5<br>N=9 | | | |
| | | | | | | 2-2-2<br>N=4 | | | |
| | | 5.0 (21)<br>***Boring Terminated at 5 Feet*** | 5 | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
While drilling
Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
11-03-2025

**Boring Completed**
11-03-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. P-02

| Model Layer | Graphic Log | Location: See Exploration Plan<br>Latitude: 35.6384° Longitude: -77.3621°<br>Depth (Ft.) — Approximate Elevation: 26 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|---|
| | | 0.3 **TOPSOIL**, 4 inches — 25.67 | | | | | | | |
| 1 | | **SILTY SAND (SM)**, orange, loose to medium dense | | | | 2-7-7-6<br>N=14 | | | |
| | | | | | | 4-3-2-3<br>N=5 | | | |
| | | 5.0 — 21 | 5 | | | 3-5-5-6<br>N=10 | | | |
| | | **POORLY GRADED SAND (SP)**, orange, medium dense | | | | | | | |
| | | 6.0 — 20 | | | | | | | |
| | | ***Boring Terminated at 6 Feet*** | | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
Groundwater not encountered

Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
10-29-2025

**Boring Completed**
10-29-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. P-03

| Model Layer | Graphic Log | Location: See Exploration Plan<br>Latitude: 35.6387° Longitude: -77.3618°<br>Depth (Ft.) — Approximate Elevation: 26 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.3 **TOPSOIL**, 3 inches (25.75)<br>**SILTY SAND (SM)**, dark brown to orange, loose to medium dense, trace organics | | ▽ | | 4-5-5<br>N=10 | | | |
| | | | | | | 1-2-3<br>N=5 | | | |
| | | 5.0 (21)<br>***Boring Terminated at 5 Feet*** | 5 | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
▽ While drilling
Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
11-04-2025

**Boring Completed**
11-04-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. P-04

Location: See Exploration Plan

Latitude: 35.6387° Longitude: -77.3612°

Depth (Ft.) Approximate Elevation: 24 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.2 **TOPSOIL**, 2 inches | | | | | | |
| | | 23.83 **SILTY SAND (SM)**, brown to orange, loose, trace organics | | | | | | |
| | | | ▽ | | 2-2-2 N=4 | | | |
| | | | | | 1-1-3 N=4 | | | |
| | | 5.0 19 | | | | | | |
| | | 5 ***Boring Terminated at 5 Feet*** | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
▽ While drilling
Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Logged by**
TAS

**Boring Started**
11-04-2025

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Boring Completed**
11-04-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. P-05

Location: See Exploration Plan

Latitude: 35.6396° Longitude: -77.3619°

Depth (Ft.) Approximate Elevation: 25 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.2 **TOPSOIL**, 2 inches | | | | | | |
| | | 24.83 **SILTY CLAYEY SAND (SC-SM)**, loose to medium dense, trace organics | | | | | | |
| | | | ▽ | | 2-3-3 N=6 | 16.5 | 18-11-7 | 43.1 |
| | | | ▨ | | 3-5-6 N=11 | | | |
| | | 5.0 | | | | | | |
| | | 20 | | | | | | |
| | | 5 ***Boring Terminated at 5 Feet*** | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
▽ While drilling
▨ Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

**Boring Started**
11-03-2025

**Boring Completed**
11-03-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. P-06

| Model Layer | Graphic Log | Location: See Exploration Plan<br>Latitude: 35.6401° Longitude: -77.3620°<br>Depth (Ft.) — Approximate Elevation: 25 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.3 **TOPSOIL**, 3 inches — 24.75<br>**SILTY SAND (SM)**, dark brown to orange, loose to medium dense | | | | 6-7-9<br>N=16 | | | |
| | | | | ▽ | | | | | |
| | | | | ▨ | | 5-4-4<br>N=8 | 16.6 | | |
| | | 5.0 — 20<br>***Boring Terminated at 5 Feet*** | 5 | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
▽ While drilling
▨ Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Logged by**
TAS

**Boring Started**
11-03-2025

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Boring Completed**
11-03-2025

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Boring Log No. P-07

Location: See Exploration Plan

Latitude: 35.6394° Longitude: -77.3626°

Depth (Ft.) Approximate Elevation: 26 (Ft.)

| Model Layer | Graphic Log | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Water Content (%) | Atterberg Limits LL-PL-PI | Percent Fines |
|---|---|---|---|---|---|---|---|---|
| 1 | | 0.2 **TOPSOIL**, 2 inches (25.83) | | | | | | |
| | | **SILTY SAND (SM)**, orange, medium dense | | | 2-5-5 N=10 | | | |
| | | 3.0 (23) | | | | | | |
| | | **POORLY GRADED SAND (SP)**, loose | | | 3-3-3 N=6 | 14.7 | | |
| | | 5.0 (21) | | | | | | |
| | | ***Boring Terminated at 5 Feet*** | | | | | | |

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation was obtained using Google Earth Pro

**Water Level Observations**
While drilling

Cave-in

**Drill Rig**
3126 GT

**Hammer Type**
Automatic

**Driller**
MR/TM

**Notes**

**Advancement Method**
Mud Rotary

**Abandonment Method**
Boring backfilled with soil cuttings and bentonite chips upon completion.

**Logged by**
TAS

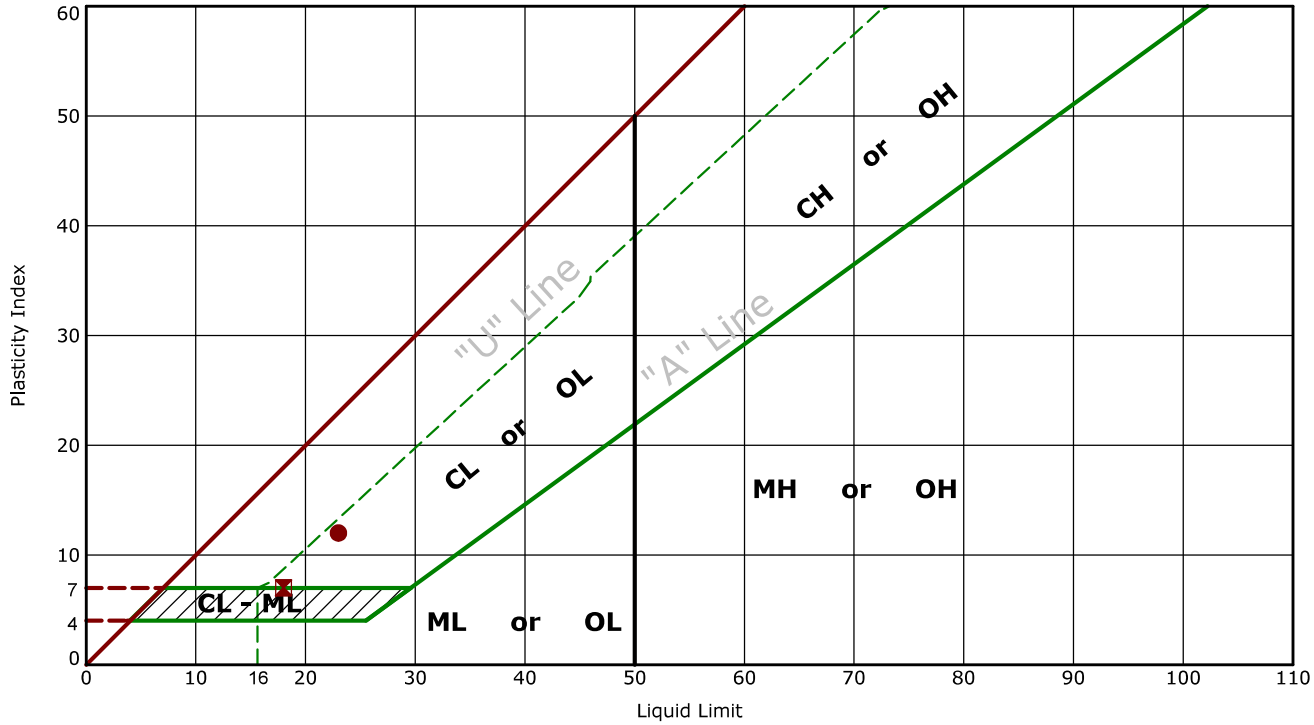
**Boring Started**
11-03-2025

**Boring Completed**
11-03-2025

Terracon
314 Beacon Dr
Winterville, NC

# Atterberg Limit Results

## ASTM D4318



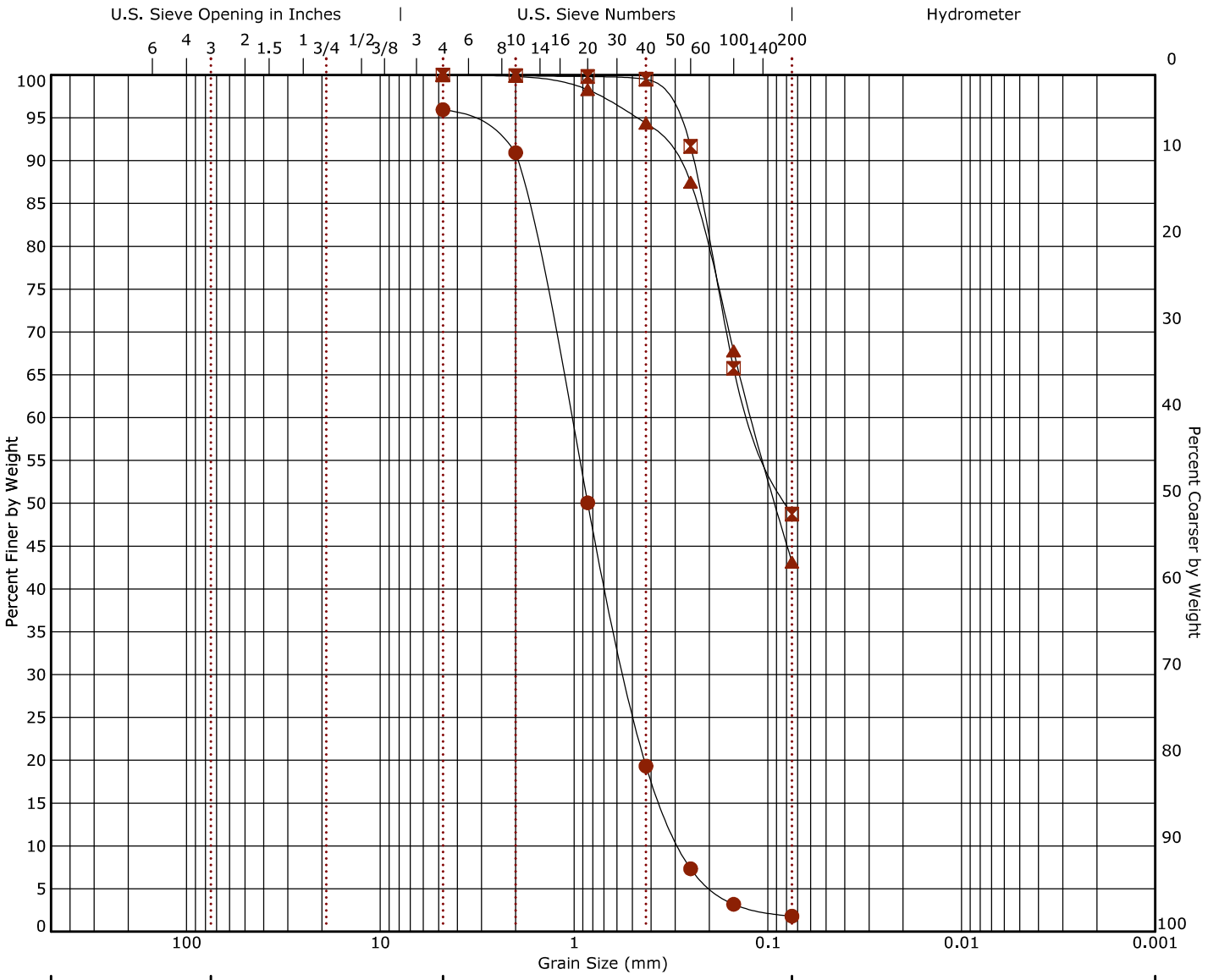

| | Boring ID | Depth (Ft) | LL | PL | PI | Fines | USCS | Description |
|---|---|---|---|---|---|---|---|---|
| ● | B-05 | 18.5 - 20 | 23 | 11 | 12 | 48.7 | SC | CLAYEY SAND |
| ⊠ | P-05 | 1 - 2.5 | 18 | 11 | 7 | 43.1 | SC-SM | SILTY, CLAYEY SAND |

Pitt County New Administration Building
Health Drive and Government Circle | Greenville, NC
Terracon Project No. 72255088

Terracon
314 Beacon Dr
Winterville, NC

# Grain Size Distribution

## ASTM D422 / ASTM C136 / AASHTO T27




| Cobbles | Gravel | | Sand | | | Silt or Clay |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Boring ID | Depth | % Cobbles | % Gravel | % Sand | % Fines | % Silt | % Clay | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-04 | 13.5 - 15 | | | 94.2 | 1.8 | | | SP |
| ⊠ | B-05 | 18.5 - 20 | 0.0 | 0.0 | 51.3 | 48.7 | | | SC |
| ▲ | P-05 | 1 - 2.5 | 0.0 | 0.0 | 56.9 | 43.1 | | | SC-SM |

| | Description |
|---|---|
| ● | POORLY GRADED SAND |
| ⊠ | CLAYEY SAND |
| ▲ | SILTY, CLAYEY SAND |

| Remarks |
|---|
| ● |
| ⊠ |
| ▲ |

| ● | | ⊠ | | ▲ | |
|---|---|---|---|---|---|
| Sieve | % Finer | Sieve | % Finer | Sieve | % Finer |
| #4 | 95.95 | #4 | 100.0 | #4 | 100.0 |
| #10 | 90.93 | #10 | 99.93 | #10 | 99.83 |
| #20 | 50.06 | #20 | 99.83 | #20 | 98.29 |
| #40 | 19.32 | #40 | 99.51 | #40 | 94.36 |
| #60 | 7.33 | #60 | 91.67 | #60 | 87.47 |
| #100 | 3.18 | #100 | 65.76 | #100 | 67.79 |
| #200 | 1.79 | #200 | 48.74 | #200 | 43.12 |

| Grain Size | ● | ⊠ | ▲ |
|---|---|---|---|
| $D_{60}$ | 1.047 | 0.119 | 0.121 |
| | | | |
| $D_{10}$ | 0.281 | | |

| Coefficients | ● | ⊠ | ▲ |
|---|---|---|---|
| $C_C$ | 0.99 | | |
| $C_U$ | 3.72 | | |

# Supporting Information

**Contents:**

General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.

Terracon
314 Beacon Dr
Winterville, NC

# General Notes

| Sampling | Water Level | Field Tests |
|---|---|---|
| Standard Penetration Test | Water Initially Encountered<br>Water Level After a Specified Period of Time<br>Water Level After a Specified Period of Time<br>Cave In Encountered<br><br>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations. | N Standard Penetration Test Resistance (Blows/Ft.)<br>(HP) Hand Penetrometer<br>(T) Torvane<br>(DCP) Dynamic Cone Penetrometer<br>UC Unconfined Compressive Strength<br>(PID) Photo-Ionization Detector<br>(OVA) Organic Vapor Analyzer |

## Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

## Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

## Strength Terms

| **Relative Density of Coarse-Grained Soils** (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance | | **Consistency of Fine-Grained Soils** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance | | |
|---|---|---|---|---|
| **Relative Density** | **Standard Penetration or N-Value (Blows/Ft.)** | **Consistency** | **Unconfined Compressive Strength Qu (tsf)** | **Standard Penetration or N-Value (Blows/Ft.)** |
| Very Loose | 0 - 3 | Very Soft | less than 0.25 | 0 - 1 |
| Loose | 4 - 9 | Soft | 0.25 to 0.50 | 2 - 4 |
| Medium Dense | 10 - 29 | Medium Stiff | 0.50 to 1.00 | 5 - 8 |
| Dense | 30 - 50 | Stiff | 1.00 to 2.00 | 9 - 15 |
| Very Dense | > 50 | Very Stiff | 2.00 to 4.00 | 16 - 30 |
| | | Hard | > 4.00 | > 30 |

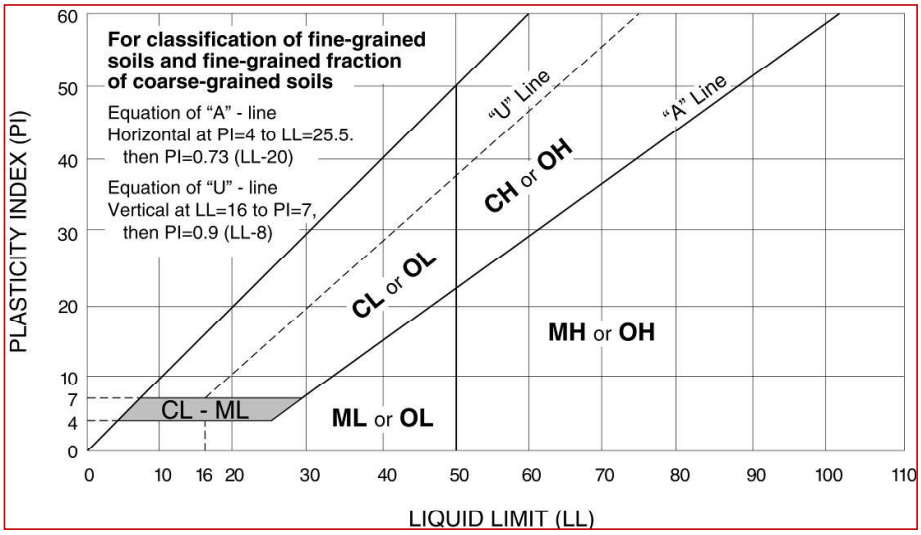
## Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

# Unified Soil Classification System

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A] | | | | Soil Classification | |
|---|---|---|---|---|---|
| | | | | Group Symbol | Group Name [B] |
| **Coarse-Grained Soils:** More than 50% retained on No. 200 sieve | **Gravels:** More than 50% of coarse fraction retained on No. 4 sieve | **Clean Gravels:** Less than 5% fines [C] | Cu≥4 and 1≤Cc≤3 [E] | GW | Well-graded gravel [F] |
| | | | Cu<4 and/or [Cc<1 or Cc>3.0] [E] | GP | Poorly graded gravel [F] |
| | | **Gravels with Fines:** More than 12% fines [C] | Fines classify as ML or MH | GM | Silty gravel [F, G, H] |
| | | | Fines classify as CL or CH | GC | Clayey gravel [F, G, H] |
| | **Sands:** 50% or more of coarse fraction passes No. 4 sieve | **Clean Sands:** Less than 5% fines [D] | Cu≥6 and 1≤Cc≤3 [E] | SW | Well-graded sand [I] |
| | | | Cu<6 and/or [Cc<1 or Cc>3.0] [E] | SP | Poorly graded sand [I] |
| | | **Sands with Fines:** More than 12% fines [D] | Fines classify as ML or MH | SM | Silty sand [G, H, I] |
| | | | Fines classify as CL or CH | SC | Clayey sand [G, H, I] |
| **Fine-Grained Soils:** 50% or more passes the No. 200 sieve | **Silts and Clays:** Liquid limit less than 50 | **Inorganic:** | PI > 7 and plots above "A" line [J] | CL | Lean clay [K, L, M] |
| | | | PI < 4 or plots below "A" line [J] | ML | Silt [K, L, M] |
| | | **Organic:** | $\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$ | OL | Organic clay [K, L, M, N] |
| | | | | | Organic silt [K, L, M, O] |
| | **Silts and Clays:** Liquid limit 50 or more | **Inorganic:** | PI plots on or above "A" line | CH | Fat clay [K, L, M] |
| | | | PI plots below "A" line | MH | Elastic silt [K, L, M] |
| | | **Organic:** | $\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$ | OH | Organic clay [K, L, M, P] |
| | | | | | Organic silt [K, L, M, Q] |
| **Highly organic soils:** | Primarily organic matter, dark in color, and organic odor | | | PT | Peat |

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



# Statement of Special Inspections

Project: Pitt County New Administration Building
Location: Greenville, NC
Owner's Representative:
Owner's Address:

This Statement of Special Inspections is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the 2018 North Carolina State Building Code. It includes a Schedule of Special Inspection Services applicable to this project, the name of the Special Inspector, the identity of other approved agencies retained for conducting Special Inspections, and the required inspector qualifications. This Statement of Special Inspections was prepared by the following Designers of Record:

| | | | |
|---|---|---|---|
| Structural | Kevin M. Roomsburg, PE | | |
| | (Type or print name) | (Signature) | (Date) |
| Architectural | John K. Farkas, AIA | | |
| | (Type or print name) | (Signature) | (Date) |
| Mechanical | | | |
| | (Type or print name) | (Signature) | (Date) |
| Other | | | |
| | (Type or print name) | (Signature) | (Date) |

The Special Inspector shall keep records of all special inspections and tests and shall furnish reports to the State Construction Office and the Designers of Record. Reports shall indicate if the work inspected or tested was or was not completed in conformance with the approved construction documents. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the State Construction Office and the Designers of Record. The Special Inspections program does not relieve the Contractor of his or her responsibilities.

A Final Report of Special Inspections documenting completion of all required Special Inspections, testing, and correction of any discrepancies should be submitted prior to issuance of a Certificate of Use and Occupancy.

Job Site safety and means and methods of construction are solely the responsibility of the Contractor.

Owner's Authorization

Signature Date

Accepted for the City/County by:

Signature Date

## Schedule of Special Inspection Services[a]

The following sheets comprise the required schedule of special inspections for this project. The construction divisions which require special inspections for this project are as follows.

- ☒ Structural Steel & High Strength Bolting
- ☒ Welding of Structural Steel
- ☒ Cold-Formed Steel Deck
- ☒ Open-Web Steel Joists & Joist Girders
- ☒ Cold-Formed Steel Framing
- ☒ Concrete Construction
- ☒ Masonry Construction [b]
- ☐ Wood Construction
- ☒ Soils
- ☐ Driven Deep Foundations
- ☐ Cast-in-Place Deep Foundations
- ☐ Helical Pile Foundations
- ☐ Rammed Aggregate Piers & Stone Columns
- ☐ Sprayed Fire-Resistant Material
- ☐ Mastic & Intumescent Fire-Resistant Coatings
- ☐ Exterior Insulation & Finish System
- ☐ Fire-Resistant Penetrations & Joints
- ☐ Smoke Control
- ☐ Retaining Wall & Systems > 5 Feet
- ☐ Special Inspections for Wind Resistance
- ☐ Special Inspections for Seismic Resistance

a. The inspection frequency indicated on the following inspection tables are “C” continuous, “P” periodic, & “O” random on a daily basis.
b. Level A is the minimum inspection program for empirically / prescriptively designed masonry in Risk Category I, II or III structures. Level B is the minimum inspection program for empirically / prescriptively designed masonry in Risk Category IV structures and engineered masonry in Risk Category I, II or III structures. Level C is the minimum inspection program for engineered masonry in Risk Category IV structures. Engineered masonry structures are those designed in accordance with portions of the TMS 402-13 / ACI 530-13/ASCE 5-13 other than Part 4 or Appendix A.

| Inspection Agents | Firm Name & Point of Contact | Address / Phone / E-mail |
|---|---|---|
| 1. Special Inspector (SI-1) | **NRW Engineering, P.C.<br>Kenneth B. Fuss, P.E.** | **748 Lord Dunmore Drive<br>Virginia Beach, VA 23464<br>(757) 474-0612<br>kbf@nrwengineering.com** |
| 2. Testing Agency (TA-1) | | |
| 3. Testing Agency (TA-2) | | |
| 4. Geotechnical Engineer (GE-1) | | |
| 5. Other (O-1) | | |

Note: The inspection and testing agent(s) shall be engaged by the Owner or the Registered Design Professional of Record acting as the Owner’s agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the State Construction Office, prior to commencing work.

Seismic Design Category: ☐ A ☒ B ☐ C ☐ D

Basic Wind Speed ($V_{asd}$): ☒ 90-109mph ☐ 110-119mph ☐ ≥120mph

Wind Exposure Category: ☐ B ☒ C ☐ D

Schedule of Special Inspection Services
**Structural Steel and High-Strength Bolting**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | AISC 360 | NCBC | |
| 1. Fabricator Certification / Verification of Quality Control Procedures | | | | | 1 |
| a. Verify fabricator qualifications | ☒ | C | | 1704.2.5.1 | 1 |
| b. Review material test reports & certifications | ☒ | C | N5.2 | | 1 |
| c. Collect certificates of compliance from the steel fabricator at completion of fabrication | ☒ | C | | 1704.5 | 1 |
| 2. Inspections Prior to High-Strength Bolting at Pretensioned and Slip-Critical Joints | | | | | |
| a. Collect manufacturer's certifications for fastener materials | ☒ | C | Table (Tbl) N5.6-1 | | 1 |
| b. Fasteners are marked per ASTM requirements | ☒ | P | Tbl N5.6-1 | | 2 |
| c. Ensure correct fasteners and bolting procedures are selected for joint details | ☒ | P | Tbl N5.6-1 | | 2 |
| d. Verify connecting elements, including the appropriate faying surface condition and hole preparation when specified, comply with the construction documents | ☒ | P | Tbl N5.6-1 | | 2 |
| e. Observe and document pre-installation verification testing by installation personal for fastener assemblies and methods | ☒ | P | Tbl N5.6-1 | | 2 |
| f. Verify proper storage provided for all fastener components | ☒ | P | Tbl N5.6-1 | | 2 |
| 3. Inspections During High-Strength Bolting at Pretensioned and Slip-Critical Joints | | | | | |
| a. Ensure correct fastener assemblies placed in all holes and washers, when specified, are positioned as required | ☒ | P | Tbl N5.6-2 | | 2 |
| b. Verify joint brought to snug-tight condition prior to pretensioning | ☒ | P | Tbl N5.6-2 | | 2 |
| c. Verify fastener components not turned by the wrench prevented from rotating | ☒ | P | Tbl N5.6-2 | | 2 |
| d. Ensure fasteners are pretensioned in accordance with RCSC, progressing from the most rigid point towards free edges | ☒ | P | Tbl N5.6-2 | | 2 |
| 4. Document acceptance or rejection of bolted connections after high-strength bolting is complete | ☒ | C | Tbl N5.6-3 | | 2 |
| 5. Structural Details | | | | | |
| a. Verify diameter, grade, type and length of anchor rods and other embedded items supporting structural steel | ☒ | P | N5.7 | | 1 |
| b. Inspection of fabricated assemblies & erected steel framing verifying compliance with the construction documents | ☒ | P | N5.7 | | 1/2 |
| 6. Composite Construction | | | | | |
| a. Verify placement & installation of steel deck | ☒ | P | Tbl N6.1 | | 1/2 |
| b. Observe placement and installation of steel headed stud anchors | ☒ | P | Tbl N6.1 | | 2 |
| c. Document acceptance or rejection of composite construction elements | ☒ | P | Tbl N6.1 | | 2 |

Schedule of Special Inspection Services
**Welding of Structural Steel**

| Inspection Task | Task Req'd | Freq | Code Reference | | Agent |
|---|---|---|---|---|---|
| | | | AISC 360 | NCBC | |
| 1. Inspections Prior to Welding | | | N5.4 | | |
| a. Collect & review welding procedure specification (WPS) and verify manufacturer certifications for welding consumables | ☒ | C | Table (Tbl) N5.4-1 | | 1 |
| b. Confirm weld material type & grade | ☒ | P | Tbl N5.4-1 | | 2 |
| c. Confirm method of welder identification | ☒ | P | Tbl N5.4-1 | | 2 |
| d. Inspection of fit-up for groove & fillet welds including access hole configuration & finish | ☒ | P | Tbl N5.4-1 | | 2 |
| 2. Inspections During Welding | | | N5.4 | | |
| a. Verify welder qualifications | ☒ | P | Tbl N5.4-2 | | 2 |
| b. Verify proper control and handling of welding consumables | ☒ | P | Tbl N5.4-2 | | 2 |
| c. Monitor environmental conditions | ☒ | P | Tbl N5.4-2 | | 2 |
| d. Monitor proper implementation of WPS | ☒ | P | Tbl N5.4-2 | | 2 |
| e. Inspection of welding techniques including no welding over cracked tack welds | ☒ | P | Tbl N5.4-2 | | 2 |
| 3. Inspections After Welding | | | N5.4, N5.5 | | |
| a. Verify welds have been cleaned | ☒ | P | Tbl N5.4-3 | | 2 |
| b. Confirm the installed size, length and location of welds matches the contract documents | ☒ | C | Tbl N5.4-3 | | 2 |
| c. Verify welds meet visual acceptance criteria | ☒ | C | Tbl N5.4-3 | | 2 |
| d. Confirm arc strikes comply with Part 5.28 of AWS D1.1 | ☒ | C | Tbl N5.4-3 | | 2 |
| e. Visually observe web k-area for cracks within 3" of welded doubler plates, continuity plates and stiffeners | ☐ | C | Tbl N5.4-3 | | |
| f. Backing and weld tabs removed per contract documents | ☐ | C | Tbl N5.4-3 | | |
| g. Observe and inspect weld repair activities | ☒ | C | Tbl N5.4-3 | | 2 |
| h. For Risk Category III or IV structures, conduct ultrasonic testing (UT) of CJP groove welds in materials ≥ 5/16" at butt, T- and corner joints subject to transversely applied tension loading | ☒ | C | N.5.5b, N5.5e | | 2 |
| i. For Risk Category II structures, conduct ultrasonic testing (UT) of CJP groove welds in materials ≥ 5/16" at butt, T- and corner joints subject to transversely applied tension loading | ☐ | P | N.5.5b, N5.5f | | |
| j. Conduct magnetic particle testing (MT) or liquid penetrant testing (PT) at thermally cut surfaces of access holes for rolled section with tf > 2" and built-up shape with tw > 2" | ☐ | C | N5.5c | | |
| k. Radiographic or ultrasonic inspection at joints subject to fatigue | ☐ | C | N5.5d, Tbl A-3.1 | | |
| l. Document acceptance / rejection of welded joints and members | ☒ | C | Tbl N5.4-3, N5.5g | | 2 |

Schedule of Special Inspection Services
**Cold-Formed Steel Deck**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | SDI QA/QC | NCBC | |
| 1. Prior to deck placement, verify deck and deck accessories comply with the construction documents | ☒ | C | Table (Tbl) 1.1 | | 1 |
| 2. Inspection Tasks After Deck Placement | | | | | |
| a. Verify the installation of deck & deck accessories complies with the construction documents | ☒ | C | Tbl 1.2 | | 1/2 |
| b. Verify that deck materials' mill certifications comply with the construction documents | ☒ | C | Tbl 1.2 | | 1 |
| 3. Inspection Tasks Prior to Deck Welding | | | | | |
| a. Collect welding procedure specification (WPS) | ☒ | P | Tbl 1.3 | | 1 |
| b. Collect manufacturer certifications for welding consumables | ☒ | P | Tbl 1.3 | | 1 |
| c. Verify material type and grade | ☒ | P | Tbl 1.3 | | 2 |
| d. Check welding equipment | ☒ | P | Tbl 1.3 | | 2 |
| 4. Inspection Tasks During Deck Welding | | | | | |
| a. Verify welder qualifications | ☒ | P | Tbl 1.4 | | 2 |
| b. Verify proper control and handling of welding consumables | ☒ | P | Tbl 1.4 | | 2 |
| c. Monitor environmental conditions | ☒ | P | Tbl 1.4 | | 2 |
| d. Monitor proper implementation of WPS | ☒ | P | Tbl 1.4 | | 2 |
| 5. Inspection Tasks After Welding | | | | | |
| a. Verify size and location of welds, including support, sidelap and perimeter welds | ☒ | C | Tbl 1.5 | | 2 |
| b. Verify welds meet visual acceptance criteria | ☒ | C | Tbl 1.5 | | 2 |
| c. Observe weld repair activities | ☒ | C | Tbl 1.5 | | 2 |
| 6. Inspection Tasks Prior to Mechanical Fastening | | | | | |
| a. Verify manufacturer installation instructions available for mechanical fasteners | ☒ | P | Tbl 1.6 | | 2 |
| b. Proper tools available for fastener installation | ☒ | P | Tbl 1.6 | | 2 |
| c. Verify proper storage of mechanical fasteners | ☒ | P | Tbl 1.6 | | 2 |
| 7. Inspection Tasks During Mechanical Fastening | | | | | |
| a. Observe fastener spacing and position | ☒ | P | Tbl 1.7 | | 2 |
| b. Verify fasteners are installed in accordance with manufacturer's instructions | ☒ | P | Tbl 1.7 | | 2 |
| 8. Inspection Tasks After Mechanical Fastening | | | | | |
| a. Check spacing, type and installation of support fasteners | ☒ | C | Tbl 1.8 | | 2 |
| b. Check spacing, type, and installation of sidelap fasteners | ☒ | C | Tbl 1.8 | | 2 |
| c. Check spacing, type, and installation of perimeter fasteners | ☒ | C | Tbl 1.8 | | 2 |
| d. Verify repair activities | ☒ | C | Tbl 1.8 | | 2 |
| 9. Document acceptance or rejection of deck & deck accessories for all phases of construction | ☒ | C | Tbls 1.1 thru 1.8 | | 2 |

Schedule of Special Inspection Services
**Open-Web Steel Joists and Joist Girders**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Fabricator Certification / Verification of Quality Control Procedures | | | | | |
| a. Verify fabricator qualifications | ☒ | C | | 1704.2.5.1 | 1 |
| b. Collect certificate of compliance from steel joist producer at completion of manufacture | ☒ | C | | 1704.5, 2207.5 | 1 |
| 2. Observe bolted and welded joist end connections | ☒ | P | SJI-K 5.3, 5.6, SJI-LH/DLH 104.4, 104.7, SJI-JG 1004.4, 1004.6, SJI-CJ 104.4, 104.7 | Table (Tbl) 1705.2.3 | 2 |
| 3. Verify size, spacing and connection of standard horizontal and diagonal bridging | ☒ | P | SJI-K 5.4, SJI-LH/DLH 104.5, SJI-JG 1004.5, 1004.9, SJI-CJ 104.5 | Tbl 1705.2.3 | 1/2 |
| 4. Verify size, spacing and connection of bridging that differs from the SJI specifications listed by Part 2207.1 of the NCBC | ☐ | P | | Tbl 1705.2.3 | |

Schedule of Special Inspection Services
**Cold-Formed Steel Framing**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Fabricator Certification / Verification of Quality Control Procedures | | | | | |
| a. Verify fabricator qualifications | ☒ | C | | 1704.2.5.1 | 1 |
| b. Collect certificates of compliance from the steel fabricator at completion of fabrication | ☒ | C | | 1704.5 | 1 |
| 2. For trusses clear spanning 60 feet or more, verify that both temporary and permanent restraints and braces are installed in accordance with the approved truss submittal package. | ☐ | P | | 1705.2.4 | |

Schedule of Special Inspection Services
**Concrete Construction**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard[a] | NCBC | |
| 1. Inspect reinforcement, including prestressing tendons, and verify placement | ☒ | P | ACI Ch.20, 25.2, 25.3, 26.6.1-26.6.3 | 1908.4 | 1 |
| 2. Reinforcing Bar Welding: | | | AWS D1.4 | | |
| e. Verify weldability of reinforcing bars other than ASTM A706 and collect reports | ☐ | P | ACI 26.6.4 | 1704.5 | |
| f. Inspect single-pass fillet welds ≤ 5/16" | ☒ | P | ACI 26.6.4 | | 2 |
| g. Inspect all welds other than single-pass fillet welds ≤ 5/16" | ☐ | C | ACI 26.6.4 | | |
| 3. Concrete Anchors: | | | | | |
| a. Inspect anchors cast in concrete | ☒ | P | ACI 17.8.2 | | 1 |
| b. Inspect adhesive anchors installed in hardened concrete with horizontally or upwardly inclined orientations that resist sustained tension loads | ☐ | C | ACI 17.8.2.4 | | |
| c. Inspect adhesive anchors installed in hardened concrete with orientations different from Item 3.b | ☒ | P | ACI 17.8.2 | | 2 |
| d. Inspect mechanical anchors installed in hardened concrete | ☒ | P | ACI 17.8.2 | | 2 |
| 4. Collect mix designs and verify the correct mix used during installation | ☒ | P | ACI Ch19, 26.4.3, 26.4.4 | 1904.1, 1904.2, 1908.2, 1908.3 | 1 |
| 5. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete | ☒ | C | ASTM C172, ASTM C31, ACI 26.4, 26.12 | 1908.10 | 2 |
| 6. Inspect concrete and shotcrete placement for proper application techniques | ☒ | C | ACI 26.5 | 1908.6, 1908.7, 1908.8 | 2 |
| 7. Collect reports of preconstruction tests for shotcrete when preconstruction tests are required by NCBC Section 1908.4 | ☐ | C | | 1704.5, 1908.5 | |
| 8. Verify maintenance of specified curing temperature and techniques | ☒ | P | ACI 26.5.3-26.5.5 | 1908.9 | 1/2 |
| 9. Inspections for prestressed concrete | | | | | |
| a. Observe application of prestressing force | ☐ | C | ACI 26.10 | | |
| b. Inspect grouting of bonded prestressing tendons | ☐ | C | ACI 26.10 | | |
| 10. Verify concrete strength prior to stressing of PT tendons and prior to removal of shores and forms from PT & mild beams and structural slabs | ☐ | P | ACI 26.11.2 | | |
| 11. Inspect erection of precast members | ☐ | P | ACI 26.8 | | |
| 12. Inspect formwork for shape, location and dimensions of the concrete member being formed | ☐ | P | ACI 26.11.1.2(b) | | |
| 13. Collect mill test reports for ASTM A615 rebar used by SFRS special moment frames, special structural walls or coupling beams | ☐ | C | ACI 20.2.2.5 | 1704.5 | |

a. References to "ACI" in this table are to the ACI 318-14.

Schedule of Special Inspection Services
**Masonry – Level A**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | TMS 402[a] | TMS 602[a] | |
| 1. Prior to construction, verify certificates of compliance used in masonry construction | ☐ | P | Table 3.1.1 | Art. 1.5 | |

a. References to "TMS402" in this table are to the TMS402/ACI530/ASCE5-13. References to "TMS602" are to TMS602/ACI530.1/ASCE6-13.

Schedule of Special Inspection Services
**Masonry – Level B**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | TMS 402[a] | TMS 602[a] | |
| 1. Test & verify slump flow & visual stability index as delivered to site for self-consolidating grout | ☐ | C | Table (Tbl) 3.1.2 | Art. 1.5B.1.b.3 | |
| 2. Test & verify f'm & $f'_{AAC}$ prior to construction | ☐ | C | Tbl 3.1.2 | Art. 1.4B | |
| 3. Verify compliance with the approved submittals | ☒ | P | Tbl 3.1.2 | Art. 1.5 | 1 |
| 4. As masonry construction begins, verify that the following are in compliance: | | | | | |
| a. Proportions of site-prepared mortar | ☒ | P | | Art. 2.1, 2.6A | 2 |
| b. Construction of mortar joints | ☒ | P | | Art. 3.3B | 2 |
| c. Grade and size of prestressing tendons and anchorages | ☐ | P | | Art. 2.4B, 2.4H | |
| d. Location of reinforcement, connectors and prestressing tendons and anchorages | ☒ | P | | Art. 3.4, 3.6A | 1/2 |
| e. Prestressing technique | ☐ | P | | Art. 3.6B | |
| f. Properties of thin-bed mortar at AAC masonry | ☐ | C / $P_b$ | | Art. 2.1C | |
| 5. Prior to grouting, verify that the following comply: | | | | | |
| a. Grout space is clean, and cleanouts provided when required | ☒ | P | | Art. 3.2D, 3.2F | 2 |
| b. Grade, type & size of reinforcement & anchor bolts, & prestressing tendons & anchorage | ☒ | P | Sec. 6.1 | Art. 2.4, 3.4 | 1/2 |
| c. Placement of reinforcement, connectors, and prestressing tendons and anchorage | ☒ | P | Sec. 6.1, 6.2.1, 6.2.6, 6.2.7 | Art.3.2E, 3.4, 3.6A | 1/2 |
| d. Proportions of site-prepared grout and prestressing grout for bonded tendons | ☒ | P | | Art. 2.6B, 2.4G.1.b | 2 |
| e. Construction and size of mortar joints | ☒ | P | | Art. 3.3B | 2 |
| 6. Verify during construction: | | | | | |
| a. Size and location of structural elements | ☒ | P | | Art. 3.3F | 2 |
| b. Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction | ☒ | P | Sec. 1.2.1(e), 6.1.4.3, 6.2.1 | | 2 |
| c. Welding of reinforcement | ☐ | C | Sec. 8.1.6.7.2, 9.3.3.4(c), 11.3.3.4(b) | | |
| d. Preparation, construction, and protection of masonry during cold weather (temperature < 40ºF) or hot weather (temperature > 90ºF) | ☒ | P | | Art. 1.8C, 1.8D | 1/2 |
| e. Application & measurement of prestress force | ☐ | C | | Art. 3.6B | |
| f. Verify placement of grout and prestressing grout for bonded tendons | ☒ | C | | Art. 3.5, 3.6C | 2 |
| g. Placement of AAC masonry units and construction of thin-bed mortar joints | ☐ | C / $P_b$ | | Art. 3.3B.9, 3.3F.1.b | |
| 7. Observe preparation of grout specimens, mortar specimens, and or prisms | ☒ | P | | Art. 1.4.B.2.a.3, 1.4.B.2.b.3, 1.4.B.2.c.3, 1.4.B.3, 1.4.B.4 | 2 |

a. References to "TMS402" in this table are to the TMS402/ACI530/ASCE5-13. References to "TMS602" are to TMS602/ACI530.1/ASCE6-13.
b. AAC masonry shall be continuously inspected for the first 5000-square feet and periodically inspected afterwards.

Schedule of Special Inspection Services
**Masonry – Level C**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | TMS 402[a] | TMS 602[a] | |
| 1. Test & verify f'm & f'$_{AAC}$ prior to construction & for every 5,000 square feet during construction | ☐ | C | Table (Tbl) 3.1.3 | Art. 1.5 | |
| 2. Test & verify proportions of materials in premixed / preblended mortar, prestressing grout, and grout other than self-consolidating, as delivered to site | ☐ | C | Tbl 3.1.3 | | |
| 3. Test & verify slump flow & visual stability index as delivered to site for self-consolidating grout | ☐ | C | Tbl 3.1.3 | Art. 1.5B.1.b.3 | |
| 4. Verify compliance with the approved submittals | ☐ | P | Tbl 3.1.3 | Art. 1.5 | |
| 5. Verify that the following are in compliance: | | | | | |
| a. Proportions of site-mixed mortar, grout and prestressing grout for bonded tendons | ☐ | P | | Art. 2.1, 2.6A, 2.6B, 2.6C, 2.4G.1.b | |
| b. Grade, type, & size of reinforcement & anchor bolts, & prestressing tendons & anchorage | ☐ | P | Sec 6.1 | Art. 2.4, 3.4 | |
| c. Placement of masonry units and construction of mortar joints | ☐ | P | | Art. 3.3B | |
| d. Placement of reinforcement, connectors, and prestressing tendons and anchorages | ☐ | C | Sec 6.1, 6.2.1, 6.2.6, 6.2.7 | Art. 3.2E, 3.4, 3.6A | |
| e. Grout space is clean, and cleanouts provided when required | ☐ | C | | Art. 3.2D, 3.2F | |
| f. Placement of grout and prestressing grout for bonded tendons | ☐ | C | | Art. 3.5, 3.6C | |
| g. Size and location of structural elements | ☐ | P | | Art. 3.3F | |
| h. Type, size, and location of anchors including other details of anchorage of masonry to structural members, frames, or other construction | ☐ | C | Sec. 1.2.1(e), 6.1.4.3, 6.2.1 | | |
| i. Welding of reinforcement | ☐ | C | Sec 8.1.6.7.2, 9.3.3.4(c), 11.3.3.4(b) | | |
| j. Preparation, construction, and protection of masonry during cold weather (temperature < 40ºF) or hot weather (temperature > 90ºF) | ☐ | P | | Art. 1.8C, 1.8D | |
| k. Application and measurement of prestressing force | ☐ | C | | Art. 3.6B | |
| l. Placement of AAC masonry units and construction of thin-bed mortar joints | ☐ | C | | Art. 3.3B.9, 3.3F.1.b | |
| m. Properties of thin-bed mortar for AAC masonry | ☐ | C | | Art. 2.1C.1 | |
| 6. Observe preparation of grout specimens, mortar specimens, and or prisms | ☐ | C | | Art. 1.4B.2.a.3, 1.4B.2.b.3, 1.4B.2.c.3, 1.4B.3, 1.4B.4 | |

a. References to "TMS402" in this table are to the TMS402/ACI530/ASCE5-13. References to "TMS602" are to TMS602/ACI530.1/ASCE6-13.

Schedule of Special Inspection Services
**Wood Construction**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Fabricator certification / verification of quality control procedures for prefabricated wood structural elements and assemblies | | | | | |
| a. Verify fabricator qualifications | ☐ | C | | 1704.2.5.1, 1705.5 | |
| b. Collect certificates of compliance from the fabricator at completion of fabrication | ☐ | C | | 1704.5, 1705.5 | |
| 2. High-load diaphragms | | | | 2306.2 | |
| a. Verify that wood structural panel sheathing is the correct grade and thickness | ☐ | P | | 1705.5.1 | |
| b. Verify nominal size of framing members and blocking at adjoining panel edges | ☐ | P | AWC-SDPWS 4.2.7.1.2 | 1705.5.1 | |
| c. Nail and or staple diameter, length, quantity and spacing comply with the contract documents | ☐ | P | | 1705.5.1 | |
| 3. For metal-plate-connected trusses clear spanning 60 feet or more, verify that both temporary and permanent restraints and braces are installed in accordance with the approved truss submittal package | ☐ | P | | 1705.5.2 | |

Schedule of Special Inspection Services
**Soils**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agents |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity | ☒ | P | | 1705.6 | 2 |
| 2. Verify excavations extend to proper depth and have reached the correct soil material | ☒ | P | | 1705.6 | 2 |
| 3. Perform classification and testing of compacted fill materials | ☒ | P | | 1705.6 | 2 |
| 4. Verify that materials used, densities, lift thickness and procedures used during placement and compaction of compacted fill are in accordance with the approved soils report and the construction documents | ☒ | C | | 1705.6 | 2 |
| 5. Prior to placement of compacted fill, verify that the subgrade has been prepared in accordance with the approved soils report and the construction documents | ☒ | P | | 1705.6 | 2 |

Schedule of Special Inspection Services
**Driven Deep Foundations** [a b c]

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agents |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Verify that deep foundation materials, sizes and lengths comply with the construction documents | ☐ | C | | 1705.7 | |
| 2. Observe pile load tests and determine capacities of test elements ensuring compliance with the construction documents. | ☐ | C | | 1705.7 | |
| 3. Inspect driving operations and maintain complete and accurate records for each element | ☐ | C | | 1705.7 | |
| 4. Verify placement, location, plumbness, hammer size and type, blow count per foot of penetration, required penetrations to achieve design capacity, tip and butt elevations, damage and anomalies | ☐ | C | | 1705.7 | |

a. For steel elements, perform additional inspections in accordance with Section 1705.2 of the North Carolina Building Code and the applicable Schedules included herein

b. For concrete elements and concrete-filled elements, perform additional inspections in accordance with Section 1705.3 of the North Carolina Building Code and the applicable Schedules included herein

c. For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge and the applicable Schedules included herein

Schedule of Special Inspection Services
**Cast-in-Place Deep Foundations** [a]

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agents |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Observe drilling operations and maintain complete and accurate records | ☐ | C | | 1705.8 | |
| 2. Verify deep foundation materials comply with the construction documents | ☐ | C | | 1705.8 | |
| 3. Verify pile placement, location, plumbness, diameters, bell diameter (if applicable), lengths, rock embedment, end-bearing strata capacity, and anomalies | ☐ | C | | 1705.8 | |
| 4. Record concrete or grout volumes | ☐ | C | | 1705.8 | |

a. For concrete elements and concrete-filled elements, perform additional inspections in accordance with Section 1705.3 of the North Carolina Building Code and the applicable Schedules included herein

Schedule of Special Inspection Services
**Helical Pile Foundations**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agents |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Confirm the following are in compliance with the construction documents prepared by the registered design professional in responsible charge: The installation equipment used, pile dimension, pile placement location, tip elevations, final depth, and final installation torque | ☐ | C | | 1705.9 | |

Schedule of Special Inspection Services
**Rammed Aggregate Piers & Stone Columns**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Verify that the pier installation program and soil parameters are in accordance with the approved soils report and the construction documents | ☐ | C | | 1705.1.1 | |
| 2. During installation, verify the aggregate properties, type and number of lifts of aggregate, pier size, installed depth, top elevation and applied ram energy | ☐ | P | | 1705.1.1 | |
| 3. Review the modulus load testing, uplift pull-out testing, bottom or crowd stabilization tests and dynamic cone penetration test results from production pier elements and verify that all comply with the design specifications | ☐ | C | | 1705.1.1 | |

Schedule of Special Inspection Services
**Sprayed Fire-Resistant Materials** [a]

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 4. Prior to the application of sprayed on fire resistant materials, verify structural member surfaces are prepared in accordance with the approved fire-resistance design and the written instructions of the approved manufacturer | ☐ | P | | 1705.14.2 | |
| 5. During the application of sprayed on fire resistant materials, verify that the following are in compliance: | | | | | |
| a. Substrate has minimum ambient temperature before and after application as specified by the fire resistance design and approved manufacturer's written instructions | ☐ | P | | 1705.14.3 | |
| b. Work area properly ventilated during and after application | | | | 1705.14.3 | |
| c. Thickness of sprayed on material conforms with the approved fire resistance design and NCBC minimums | ☐ | P | | 1705.14.4, 1705.14.4.4, 1705.14.4.5, 1705.14.4.6, 1705.14.4.7, 1705.14.4.8, 1705.14.4.9 | |
| d. The density of sprayed on materials is not less than the requirements of the approved fire-resistance design | ☐ | P | | 1705.14.5 | |
| e. The cohesive / adhesive bond strength is not less than 150 pounds per square foot | ☐ | P | | 1705.14.6 | |

a. Inspections shall be performed after the rough installation of electrical, automatic sprinkler, mechanical and plumbing systems, and suspension systems for ceilings.

Schedule of Special Inspection Services
**Mastic and Intumescent Fire-Resistant Coatings**

| Inspection Task | Task Req'd | Freq(a) | Reference for Criteria | | Agents |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Prior to application, verify preparation of substrate and suitability of primers, if present, are in accordance with approved fire resistance design, approved manufacturer's written instructions, and the requirements of AWCI 12-B | ☐ | P | AWCI 12-B | 1705.15 | |
| 2. Observe the application of fire-resistant coatings ensuring compliance with approved fire resistance design, approved manufacturer's written instructions, and the requirements of AWCI 12-B | ☐ | P | AWCI 12-B | 1705.15 | |
| 3. After adequate drying but prior to the application of any topcoat, measure the final mastic / intumescent material thickness ensuring compliance with the construction documents and approved material / installation submittals. Measurements must consider the thickness of primers or other existing coatings on the surface of the substrate. | ☐ | P | AWCI 12-B | 1705.15 | |

Schedule of Special Inspection Services
**Exterior Insulation and Finish Systems (EIFS)**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Verify that EIFS is installed in conformance with project specifications | ☐ | P | | 1705.16 | |
| 2. If a water resistive barrier coating complying with ASTM E2570 is installed over a sheathing substrate, verify that the water-barrier and drainage strip are installed in conformance with the project specifications. | ☐ | P | | 1705.16.1 | |

Schedule of Special Inspection Services
**Fire-resistant Penetrations and Joints** [a]

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Inspect through-penetration firestop systems at fire walls, fire barriers, smoke barriers and fire partition walls in accordance with ASTM E2174 | ☐ | P | | 1705.17.1, 714.3.1.2 | |
| 2. Inspect penetration firestop systems at penetrations through membranes that are part of a horizontal assembly in accordance with ASTM E2174 | ☐ | P | | 1705.17.1, 714.4.2 | |
| 3. Inspect fire-resistant joint systems in accordance with ASTM 2393 | ☐ | P | | 1705.17.2, 715.3, 715.4 | |

a. The inspection of fire-resistant penetrations and joints applies only to high-rise buildings or buildings assigned to Risk Category III or IV.

Schedule of Special Inspection Services
**Retaining Walls Exceeding 5 Feet** [a b c d]

| Inspection Task | Task Req'd | Freq[(a)] | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Foundation support system is adequate for the intended site conditions | ☐ | P | | 1807.2.5.1 | |
| 2. Verify that retaining wall materials and installations are in compliance with the construction documents | ☐ | P | | 1807.2.5.2 | |
| 3. Verify that actual soil conditions are similar to those anticipated by the approved engineered design | ☐ | P | | 1807.2.5.3 | |
| 4. Examination of backfill materials for compliance with the approved specifications | ☐ | P | | 1807.2.5.4 | |
| 5. Confirm that all subsoil drainage piping is undamaged, drains freely to the designated outlet or structure, and has been installed per the approved engineered design | ☐ | P | | 1807.2.5.4 | |

a. All retaining walls exceeding 5 feet in height require special inspections.

b. For concrete retaining walls and footings, perform additional inspections in accordance with Section 1705.3 of the North Carolina Building Code and the applicable Schedules included herein

c. For masonry retaining walls, perform additional inspections in accordance with Section 1705.4 of the North Carolina Building Code and the applicable Schedules included herein

d. For soils, perform additional inspections in accordance with Section 1705.6 of the North Carolina Building Code and the applicable Schedules included herein

Schedule of Special Inspection Services
**Smoke Control**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. During erection of ductwork and prior to concealment, perform leakage testing and record device location(s) | ☐ | P | | 1705.18.1.1 | |
| 2. Upon completion of smoke control system, perform pressure difference testing, flow measurements, and detection and control verification | ☐ | P | | 1705.18.1.2 | |

Schedule of Special Inspection Services
**Special Inspections for Wind Resistance**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Prior to any work taking place, each contractor responsible for the construction of a wind-resisting system or component shall submit a written statement of contractor responsibility | ☐ | C | | 1704.4 | |
| 2. Structural Wood | | | | | |
| a. Verify field gluing operations pertinent to the main wind force-resisting system | ☐ | C | | 1705.11.1 | |
| b. Inspect nailing, anchoring, and fastening of components within the main windforce-resisting system including shear walls, diaphragms, drag struts, braces & hold-downs | ☐ | P | | 1705.11.1 | |
| 3. Cold-Formed Steel Light Frame Construction | | | | | |
| a. Inspect welding operations at elements of the main windforce-resisting system | ☐ | P | | 1705.11.2 | |
| b. Inspect screw attachment, bolting, anchoring, and fastening of elements within the main windforce-resisting system including shear walls, braces, diaphragms collectors, drag struts and hold-downs | ☐ | P | | 1705.11.2 | |
| 4. Wind-resisting components | | | | | |
| a. Inspect the fastening of roof covering, roof deck and supporting roof framing connections | ☐ | P | | 1705.11.3.1 | |
| b. Inspect the fastening of exterior wall coverings & the wall connections to the roof / floor diaphragms & framing members | ☐ | P | | 1705.11.3.2 | |

Structural Wood and Cold-Formed Steel Light-Frame Construction Main Wind-Force Resisting System(s) Subject to Special Inspections:

Roof Cladding Components and Connections Subject to Special Inspections:

Wall Cladding Components and Connections Subject to Special Inspections:

Schedule of Special Inspection Services
**Special Inspections for Seismic Resistance**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | Standard | NCBC | |
| 1. Prior to any work taking place, each contractor responsible for the construction of a seismic-resisting system or component shall submit a written statement of contractor responsibility | ☐ | C | | 1704.4 | |
| 2. Structural Steel (see following tables) | ☐ | O/C | | 1705.12.1 | |
| 3. Structural Wood | | | | | |
| a. Verify field gluing operations of elements of the seismic force-resisting system (SFRS) | ☐ | C | | 1705.12.2.1 | |
| b. Inspect nailing, bolting, anchoring & other fastening at elements of SFRS | ☐ | P | | 1705.12.2.2 | |
| 4. Cold-Formed Steel Light Frame Construction | | | | | |
| a. Verify welding operations of elements of the SFRS | ☐ | P | | 1705.12.3.1 | |
| b. Inspect screw attachment, bolting, anchoring, & fastening used by SFRS | ☐ | P | | 1705.12.3.2 | |
| c. Inspect special bolted moment frames | ☐ | P | | 1705.12.9 | |
| 5. Verify erection & fastening of exterior cladding, non-bearing walls and veneer | ☐ | P | | 1705.12.5 | |
| 6. Confirm anchorage of access floors | ☐ | P | | 1705.12.5.1 | |
| 7. Confirm anchorage of storage racks | ☐ | P | | 1705.12.7 | |
| 8. Collect certificates of compliance for qualifying equipment, supports, attachments & components; verify correctness of labels & installation | ☐ | C | ASCE7 13.2.2, 13.2.1 | 1705.12.4, 1705.13.2 | |
| 9. Plumbing, Mechanical, Electrical Components | | | | | |
| a. Verify anchorage of elec. equip for emergency & standby power systems | ☐ | P | | 1705.12.6 | |
| b. Verify installation & anchorage of pipe & duct systems carrying hazardous materials & associated mech units | ☐ | P | | 1705.12.6 | |
| c. Confirm the installation & anchorage of vibration isolation systems with nominal clearances ≤¼" | ☐ | P | | 1705.12.6 | |
| d. Inspect & test seismic isolation systems at seismic isolated structures | ☐ | P | ASCE7 17.8 | 1705.12.8, 1705.13.4 | |

Seismic-Force Resisting System(s) subject to Special Inspections: _____

Seismic-Resisting Components and Connections Subject to Special Inspections:

Schedule of Special Inspection Services
**Special Inspections for Seismic Resistance**
**Structural Steel & High-Strength Bolting**

| Inspection Task | Task Req'd | Freq[a] | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | AISC 341 | NCBC | |
| 1. Inspections Prior to Bolting | | | | | |
| a. Proper fasteners selected for the joint detail | ☐ | O | Table J7-1 | | |
| b. Correct bolting procedure selected for joints | ☐ | O | Table J7-1 | | |
| c. Faying surface condition, hole preparation, etc. meet applicable requirements for connecting elements | | O | Table J7-1 | | |
| d. Pre-installation verification testing by installation personnel observed for fastener assemblies and methods used | ☐ | O | Table J7-1 | | |
| e. Fastener components are stored properly | ☐ | O | Table J7-1 | | |
| 2. Inspection Tasks During Bolting | | | | | |
| a. Fastener assemblies placed in all holes and washers are positioned as required | ☐ | O | Table J7-2 | | |
| b. Joint brought to "snug tight" prior to pretensioning operation | ☐ | O | Table J7-2 | | |
| c. Fastener component not turned by the wrench prevented from rotating | ☐ | O | Table J7-2 | | |
| d. Bolt pretensioning progresses systematically from the most rigid point toward the free edge | ☐ | O | Table J7-2 | | |
| 3. After bolting activities are complete, document accepted and rejected connections | ☐ | C | Table J7-3 | | |
| 4. Verify contour, finish and dimensional tolerances of reduced beam sections (RBS) | ☐ | C | Table J8-1 | | |
| 5. Ensure no holes or unapproved attachments made by fabricator or erector in protected zone | ☐ | C | Table J8-1 | | |
| 6. Inspection of Composite Structures Prior to Concrete Placement | | | | | |
| a. Verify reinforcing steel type and grade | ☐ | O | Table J9-1 | | |
| b. Determine carbon equivalent for reinforcing steel other than ASTM A706 | ☐ | O | Table J9-1 | | |
| c. Verify reinforcing size, spacing & orientation | ☐ | O | Table J9-1 | | |
| d. Verify reinforcing steel not re-bent in field | ☐ | O | Table J9-1 | | |
| e. Reinforcing tied & supported as required | ☐ | O | Table J9-1 | | |
| d. Required reinforcing clearances are provided | ☐ | O | Table J9-1 | | |
| e. Composite member has required size | ☐ | O | Table J9-1 | | |
| 7. Inspection of Composite Structures During Concrete Placement | | | | | |
| a. Verify mix design, compressive strength, maximum aggregate size, maximum slump | ☐ | O | Table J9-2 | | |
| b. Limits on water added at the truck or pump | ☐ | O | Table J9-2 | | |
| c. Proper placement to limit segregation | ☐ | O | Table J9-2 | | |
| 8. After concrete placement of composite structures, verify specified f'c achieved at specified age | ☐ | C | Table J9-3 | | |

Schedule of Special Inspection Services
**Special Inspections for Seismic Resistance**
**Welding of Structural Steel**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | AISC 341 | NCBC | |
| 1. Visual Inspections Prior to Welding | | | | | |
| a. Verify type & grade of connection materials | ☐ | O | Table J6-1 | | |
| b. Welder identification system established | ☐ | O | Table J6-1 | | |
| c. Fit-up & joint geometry of groove welds<br>• Joint preparation<br>• Dimensions including alignment, root opening, root face & bevel<br>• Cleanliness of steel surfaces<br>• Tack weld quality & location<br>• Backing type & fit | | O | Table J6-1 | | |
| d. Verify configuration & finish of access holes | ☐ | O | Table J6-1 | | |
| e. Inspect fit-up of fillet welds including dimensions, alignment, root gaps, cleanliness of steel surfaces, tack weld quality, and tack weld location | ☐ | O | Table J6-1 | | |
| 2. Visual Inspection Tasks During Welding | | | | | |
| a. Verify welding procedure specification (WPS) followed: Settings on welding equipment, travel speed, welding materials selected, shielding gas type & flow rate, preheat applied, interpass temperature maintained, weld position (F, V, H, OH), and intermix of filler metals avoided unless approved by engineer of record | ☐ | O | Table J6-2 | | |
| b. Verify welder qualifications | ☐ | O | Table J6-2 | | |
| c. Control & handling of welding consumables, including packaging & exposure | ☐ | O | Table J6-2 | | |
| d. Environmental conditions, including wind speed, precipitation & temperature, within defined limits | ☐ | O | Table J6-2 | | |
| e. Verify welding techniques: Interpass & final cleaning, each pass within profile limitations, and each pass meets quality requirements | ☐ | O | Table J6-2 | | |
| f. No welding over cracked tack welds | ☐ | O | Table J6-2 | | |
| 3. Visual Inspections Tasks After Welding | | | | | |
| g. Verify welds are cleaned | ☐ | O | Table J6-3 | | |
| h. Confirm correct weld size, length & location | ☐ | C | Table J6-3 | | |
| i. Welds meet visual acceptance criteria: Crack prohibition, weld/base-metal fusion, crater cross section, weld profiles and size, undercut & porosity | ☐ | C | Table J6-3 | | |
| j. Confirm placement of reinforcing or contouring fillet welds | ☐ | C | Table J6-3 | | |
| k. Verify backing removed, weld tabs removed & finished, and fillet welds added | ☐ | C | Table J6-3 | | |
| l. Observe repair activities | ☐ | C | Table J6-3 | | |

Schedule of Special Inspection Services
**Special Inspections for Seismic Resistance**
**Non-Destructive Testing (NDT) of Welded Joints**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | AISC 341 | Standard | |
| 1. Web base metal tested for cracks using magnetic particle testing (MT) when doubler plates, continuity plates or stiffeners are welded in the k-area. MT inspection shall include k-area metal within 3" of the weld and be performed ≥ 48hours | ☐ | C | Part J6.2a | | |
| 2. Inspect complete Joint Penetration (CJP) Groove Welds in materials ≥ 5/16" thick | | | | | |
| a. Ultrasonic testing (UT) performed on 100% of CJP groove welds except for ordinary moment frames for which only *demand critical welds* need be tested | ☐ | C | Part J6.2b, J6.2g | AWS D1.1 Table 6.2 | |
| b. MT performed on 25% of beam-to-column CJP groove welds except for ordinary moment frames for which only *demand critical welds* need be tested | ☐ | P | Part J6.2b, J.6.2h | | |
| c. At the end of welds where weld tabs have been removed (excluding continuity plate weld tabs), MT performed on 100% of beam-to-column joints receiving UT in accordance with Item 2.a above | ☐ | C | Part J6.2f, J.6.2h | | |
| 3. UT check for base metal lamellar tearing & laminations at base metal thickness ≥ 1½" loaded in tension in through-thickness direction in tee & corner joints where connected material is ≥ ¾" and contains CJP groove welds | ☐ | C | Part J6.2c | AWS D1.1 Table 6.2 | |
| 4. At welded splices & connections, MT or penetrant testing performed at thermally cut surfaces of beam copes and access holes when flange thickness > 1½" (rolled shapes) or web thickness > 1½" (built-up shape) | ☐ | C | Part J6.2d | | |
| 5. MT performed on welds & adjacent areas of reduced beam section (RBS) cut surface repaired by welding or on base metal of RBS cut surfaces if a sharp notch was removed by grinding | ☐ | C | Part J6.2e | | |

Schedule of Special Inspection Services
**Special Inspections for Seismic Resistance**
**Steel H-Piles**

| Inspection Task | Task Req'd | Freq | Reference for Criteria | | Agent |
|---|---|---|---|---|---|
| | | | AISC 341 | NCBC | |
| 1. Ensure no holes or unapproved attachments made by responsible contractor in protected zone | ☐ | C | Table J10-1 | | |

**SECTION 011000 - SUMMARY**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Contractor's use of site and premises.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and Drawing conventions.
9. Miscellaneous provisions.

1.3 PROJECT INFORMATION

A. Project Identification:

**PITT COUNTY GOVERNMENT**
**NEW ADMINSTRATION BUILDING**
**JKF PROJECT NO. 2024-14**

1. Project Location: Pitt County Office Park, Government Circle, Greenville, NC.

B. Owner: Pitt County Government.

1. Owner's Representative: **Janis Gallagher, County Manager**.

C. Architect: JKF Architecture, PC.

1. Architect's Representative: John K. Farkas, AIA LEED-AP.

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Rivers & Associates; Civil Engineers.

2. NRW Engineering; Structural Engineering.

3. Atlantec/IMEG Engineering; Fire Protection, Plumbing, HVAC, Electrical, Fire Alarm Engineering.

## 1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Construction of a new 82,740 SF, 2-story building for use as County Administrative Offices and supporting spaces, Commissioner’s Meeting Room, Flexible Meeting Space, and other Work indicated in the Contract Documents.

2. Construction includes sitework, structural steel, fire protection, mechanical/HVAC systems, plumbing, electrical power and lighting, generator, fire alarm system including BDA system.

B. Type of Contract:

1. Project will be constructed under a single-prime, pre-qualified general contract.

## 1.5 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

## 1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

## 1.7 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: With notification.
2. Early Morning Hours: With notification.
3. Work in Existing Building: With notification.

4. Hours for Utility Shutdowns: With notification.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Architect, Owner not less than two days in advance of proposed utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Architect, Owner not less than two days in advance of proposed disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

## 1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.9 MISCELLANEOUS PROVISIONS

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 011000**

**SECTION 012100 - ALLOWANCES**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:

1. Quantity allowances.

C. Related Requirements:

1. Section 012200 "Unit Prices" for procedures for using unit prices.

### 1.3 ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 SCHEDULE OF ALLOWANCES

A. **Allowance No. 1**: **Remove Unsuitable Soils**:

1. Description: Remove and disposal off-site and replace of unsuitable soils in building pad or parking areas, excluding that required for footings, foundations, and utility trenches, as directed by the architect. Suitable fill material includes compacted sand fill as specified in Section 312000 "Earth Moving." Material, labor to remove, dispose, and install, fill materials, supervision, overhead and profit, delivery charges, etc., are to be included in the Base Bid. Final quantities necessary for the project will be based on actual quantities determined by the Owner's testing agency and confirm by Designers. Adjustments made based on the final quantities shall be per Unit Price #1.

2. Base Bid Quantity to be included in Base Bid: 3,300 CY.
3. On Bid Form indicated Lump Sum dollar amount for Base Bid Quantity.
4. No changes in the Contract duration for the first 3,3000 CY that require removal and replacement. If quantities exceed 3,300 CY, adjustments to duration will be made by Unit Price #1.

B. **Allowance No. 2: Remove Unsuitable Soils (#57 Stone)**:

1. Description: Remove and dispose off-site and replace unsuitable soils in footings, foundations, and utility trenches, as directed by the architect. Suitable fill material includes #57. Labor to remove, dispose, and install, fill materials, supervision, overhead and profit, delivery charges, etc., are to be included in the Base Bid. Final quantities necessary for the project will be based on actual quantities determined by the Owner's testing agency and confirm by Designers. Adjustments made based on the final quantities shall be per Unit Price #2.
2. Base Bid Quantity to be included in Base Bid: 2,000 CY.
3. On Bid Form indicated Lump Sum amount for Base Bid Quantity.
4. No changes in the Contract duration for the first 2,000 CY that require removal and replacement. If quantities exceed 2,000 CY, adjustments to duration will be made by Unit Price #2.

**END OF SECTION 012100**

**SECTION 012200 - UNIT PRICES**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

### 1.3 DEFINITIONS

A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

### 1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

## 3.1 LIST OF UNIT PRICES

A. **Unit Price No. 1 -** Remove and replace unsuitable soils in building pad or parking areas.

1. Description: Remove and replace unsuitable soils in building pad or parking areas, excluding that required for footings, foundations, and utility trenches, as directed by the architect. Suitable fill material includes compacted sand fill above that required by the Contract Documents including Allowances, as directed by the Architect.

2. Unit of Measurement: Per cubic yard in place.
3. Add 1 calendar day to the Contract duration for every part of 1,000 CY of unsuitable soils removed. No extended overhead recovery will be permitted as part of this Unit Price.

B. **Unit Price No. 2 -** Remove and replacement unsuitable soils in footings, foundations, and utility trenches.

1. Description: Remove and replacement unsuitable soils in footings, foundations, and utility trenches, as directed by the architect. Suitable fill material may include compacted sand fill or #57 stone directed by the Architect, but use of either shall not alter the unit price.
2. Unit of Measurement: Per cubic yard in place.
3. Add 1 calendar day to the Contract duration for every part of 200 CY of unsuitable soils removed. No extended overhead recovery will be permitted as part of this Unit Price.

C. **Unit Price No. 3 -** Provide geotechnical fabric, geogrid, or other suitable stabilization material.

1. Description: Upon approval of the Architect, utilized geotechnical fabric to stabilized areas of unsuitable soils including building pad and parking area preparation. Building pad includes entire building area including excavations for footings, foundations, and utility trenches.
2. Unit of Measurement: Per square yard in place.
3. Add 1 calendar day to the Contract duration for every part of 200 SY of fabric installed. No extended overhead recovery will be permitted as part of this Unit Price.

**END OF SECTION 012200**

**SECTION 012300 - ALTERNATES**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

3.1 SCHEDULE OF ALTERNATES

A. **Alternate Bid No. 1**– Alternate Landscaping.
   1. Description: Add to Base Bid the cost for providing the additional landscaping noted on Drawing L1.1A prepared by Rivers & Associates.
   2. Time Impact: If accepted, 0 days added to Base Bid.
   3. Alternate includes additional plants, installation, and materials necessary for complete installation above and beyond that required by the Base Bid Drawing L1.1.

B. **Alternate Bid No. 2**– Preferred Alternate; Corbin-Russwin.
   1. Description: Add to Base Bid the cost for providing Corbin-Russwin Door Hardware where indicated as Basis of Design in the Hardware Schedule.
   2. Time Impact: If accepted, 0 days added to Base Bid.

**END OF SECTION 012300**

**SECTION 012500 - SUBSTITUTION PROCEDURES**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use Contractor's Standard Form.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

**PART 2 - PRODUCTS**

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 30 days after Notice to Proceed.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution provides sustainable design characteristics that specified product provided.

c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 012500**

## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

### 1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on "Architect's Supplemental Instructions."

### 1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.

1.7 CONSTRUCTION CHANGE DIRECTIVE OR FIELD ORDER

A. Construction Change Directive: Architect may issue a Construction Change Directive on Field Order Form. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 012600**

**SECTION 012900 - PAYMENT PROCEDURES**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

### 1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

### 1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

    a. Application for Payment forms with Continuation Sheets.
    b. Submittals Schedule.
    c. Contractor's Construction Schedule.

2. Submit the Schedule of Values to Architect at earliest possible date but no later than 21 days after notice to proceed.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Submit draft of **AIA Document G703 Continuation Sheets**.
2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use **AIA Document G702 and AIA Document G703 Continuation Sheets** as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. **Architect** will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Approved Change Orders issued before last day of construction period covered by application.

E. Transmittal: Submit electronically via PDF signed and notarized original copies of each Application for Payment to **Architect** by a method ensuring receipt **within 24 hours**. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Initial Payment: Initial Application for Payment will not be reviewed or executed until the following administrative submittals are submitted and approved by the Architect:

1. Project Schedule.
2. List of Subcontractors, materials, products.
3. Schedule of Values.
4. Submittal Schedule.

G. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. NC State Construction Forms "Contractor's Affidavit of Payment of Debts and Claims."
5. NC State Construction Forms "Contractor's Affidavit of Release of Liens."
6. NC State Construction Forms "Consent of Surety to Final Payment."
7. Summary of all MBE’s paid for project. Use Appendix E to Summarize.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 012900**

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

### 1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

### 1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Name of Product and Manufacturer to be provided by the Subcontractor.
5. Submit Subcontract List within 30 days of Notice to Proceed.

B. Key Personnel Names: Within 30 days of Notice to Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

## 1.7 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Contractor’s standard form acceptable to the Architect

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

## 1.8 PROJECT MEETINGS

A. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.
b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.

e. Lines of communications.
f. Procedures for processing field decisions and Change Orders.
g. Procedures for RFIs.
h. Procedures for testing and inspecting.
i. Procedures for processing Applications for Payment.
j. Distribution of the Contract Documents.
k. Submittal procedures.
l. Preparation of record documents.
m. Use of the premises.
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.
y. Security.
z. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
3. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Progress Meetings: Architect will conduct progress meetings at monthly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project. Contractor shall provide a written summary of the project status in the following format at each meeting:

a. Review outstanding items from previous minutes.
b. Contractors current status complete with written summary.
c. Contractors work to be performed next period, written summary.
d. Change Order status

e. Shop Drawing status.
f. Project Schedule.
g. Other.
h. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

D. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 013100**

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's construction schedule.
2. Construction schedule updating reports.
3. Daily construction reports.

### 1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

### 1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.
3. Two paper copies.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

C. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.

D. Daily Construction Reports: Submit at monthly intervals.

1.5 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

**PART 2 - PRODUCTS**

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Project Acceptance.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Pre-Final: Indicate completion in advance of date established for Project Acceptance and allow time for Architect's administrative procedures necessary to schedule Final Inspections.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

    a. Uninterruptible services.
    b. Use of premises restrictions.
    c. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Building flush-out.
    m. Startup and placement into final use and operation.

3. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Temporary enclosure and space conditioning.
    c. Permanent space enclosure.
    d. Completion of mechanical installation.
    e. Completion of electrical installation.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Pre-final inspections, and final completion, and the following interim milestones:

1. Temporary enclosure and space conditioning.
2. Power on Building.
3. Critical inspections such as under slab rough-in, above ceiling inspections, wall rough-ins, etc.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor

intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

## 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

## 2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.

## 2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Architect within seven day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

C. Submit 5-year weather data for the previous 5-years at the beginning of the Project within 30 days of Notice to Proceed. Data shall indicate the average number of days per month with precipitation that will serve as baseline for any weather days to be claimed in excess of the 5-year averages.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

**END OF SECTION 013200**

**SECTION 013300 - SUBMITTAL PROCEDURES**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

b. Finalize the schedule such that all shop drawings required for the project are submitted within 90 days of Notice to Proceed.

4. Format: Arrange the following information in a tabular format:

a. Scheduled date for first submittal.
b. Specification Section number and title.
c. Submittal category: Action; informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Architect's final release or approval.
g. Scheduled date of fabrication.
h. Scheduled dates for purchasing.
i. Scheduled dates for installation.
j. Activity or event number.

## 1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
b. Digital Drawing Software Program: The Contract Drawings are available in Architects current AutoCAD version.
c. Contractor shall sign Architect’s standard release form
d. The following digital data files will by furnished for each appropriate discipline:

1) Basic Floor plans.
2) Basic Reflected ceiling plans.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 20 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 20 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 20 days for initial review of each submittal.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of subcontractor.
    g. Name of supplier.
    h. Name of manufacturer.
    i. Submittal number or other unique identifier, including revision identifier.
    j. Number and title of appropriate Specification Section.
    k. Drawing number and detail references, as appropriate.
    l. Location(s) where product is to be installed, as appropriate.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.

    a. Transmittal Form for Paper Submittals: Use Contractors Standard Transmittal.
    b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:

        1) Project name.
        2) Date.
        3) Destination (To:).
        4) Source (From:).
        5) Name and address of Architect.
        6) Name of Construction Manager.
        7) Name of Contractor.
        8) Name of firm or entity that prepared submittal.
        9) Names of subcontractor, manufacturer, and supplier.
        10) Category and type of submittal.
        11) Submittal purpose and description.
        12) Specification Section number and title.
        13) Specification paragraph number or drawing designation and generic name for each of multiple items.
        14) Drawing number and detail references, as appropriate.

15) Indication of full or partial submittal.
16) Transmittal number, numbered consecutively.
17) Submittal and transmittal distribution record.
18) Remarks.
19) Signature of transmitter.

E. Electronic Submittals:(Limit to those submittals pre-approved for electronic submission by the Architect): Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. FOLLOW ARCHITECT'S "ELECTRONIC SHOP DRAWING PROTOCAL" FORMAT NOTED IN PARAGRAPH 3.3 AT THE END OF THIS SECTION.

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use Outlook Formatted e-mail as transmittal to Architect**,** containing the following information:

a. Project name.
b. Date.
c. Name and address of Architect.
d. Name of Contractor.
e. Name of firm or entity that prepared submittal.
f. Names of subcontractor, manufacturer, and supplier.
g. Category and type of submittal.
h. Submittal purpose and description.
i. Specification Section number and title.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Related physical samples submitted directly.
m. Indication of full or partial submittal.
n. Transmittal number, numbered consecutively.
o. Submittal and transmittal distribution record.
p. Other necessary identification.
q. Remarks.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## PART 2 - PRODUCTS

### 2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Action Submittals: Submit up to 5 paper copies of each submittal unless otherwise indicated. Architect will return two copies.
3. Informational Submittals: Submit up to 5 paper copies of each submittal unless otherwise indicated. Architect will not return copies.
4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

    a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

    a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

    a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of applicable Specification Section.
    e. Specification paragraph number and generic name of each item.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit 2 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect will retain 1 Sample sets; remainder will be returned.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

F. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

J. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

R. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

## 2.2 DELEGATED-DESIGN SERVICES

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

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

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit up to 5 paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### 3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Reviewed: Information submitted is in compliance with Contract Documents.
2. Reviewed as Noted: Information submitted is in compliance with Contract Documents except as noted.
3. Revise and Resubmit: Submittal does not meet Contract Documents or is incomplete, and must be resubmitted.
4. Not Reviewed: Incomplete submittal, was not required or does not require review.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

3.3 ELECTRONIC SHOP DRAWING PROTOCAL

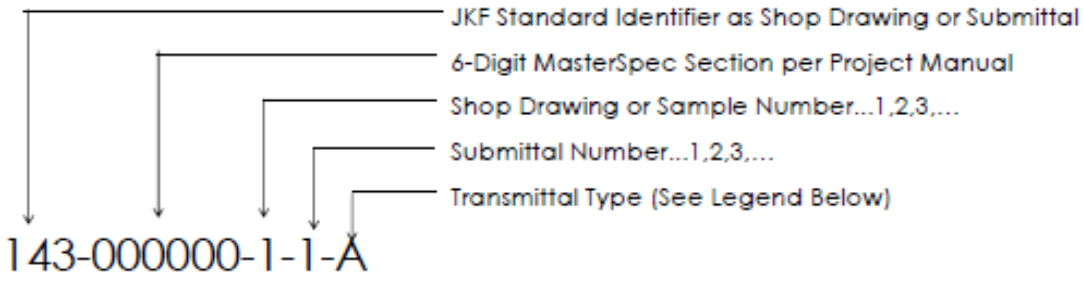
**812 SHOP DRAWINGS FOR CONTRACTORS/CONSULTANTS** Page 27

If a Contractor shall wish to submit shop drawings, project data, etc. electronically, than the JKF naming protocol shall be used as indicated below. Shop Drawings and Product Data shall be individually classified by Specification Section. Do not combine specifications within a Division. For instance, do not combine hollow metal frames, wood doors and hardware all as one PDF submittal. Breakdown all PME items into their specification components. Failure to do so will cause the submittal to be rejected.

STEP 1: Prepare your PDF submittal using the format below. For instance, a submittal of the Hardware Schedule would be named 143-087100-1-1-SD. This means it is the first submittal item for this section and the 1st submittal of this item (...1-1-...). A resubmittal of the same item if rejected the first time would be 143-087100-1-2-SD, where the 2 indicates 2nd submittal. If hardware product data was submitted, it would be named 143-087100-2-1-PD, indicating the 2nd submittal for this section, and the 1st submittal. All items must include the Contractors approval.

STEP 2: Transmit to JKF via email and use the email as your transmittal. We will not keep extraneous transmittals. JKF can provide you a transmittal template that can be saved in Outlook. All e-mails for submittals shall be sent to:

submittal@jkf-arch.com




Transmittal Type

| | |
|---|---|
| A | Transmittal from GC |
| B | Transmittal from Architect to Consultant |
| C | Transmittal from Consultant to Architect |
| D | Transmittal Architect to GC |
| E | Transmittal Architect to Owner |
| SD | Shop Drawing (Actual Documents to be Reviewed) |
| PD | Product Data (Actual Documents to be Reviewed) |
| SM | Sample |

JKF ARCHITECTURE

STEP 3: JKF ARCHITECTURE will initially review the submittal for formatting and content compliance. If required, we will forward the PDF to the required consultants for review and approval.

STEP 4: Consultants shall review the submittal and return using the same exact file name as was sent from JKF ARCHITECTURE.

STEP 5: JKF ARCHITECTURE will conduct final review for coordination and e-mail back to Contractor with final action.

STEP 6: Any further resubmittals shall follow the naming protocol that includes numbering for subsequent resubmittals for the same item.

**END OF SECTION 013300**

## SECTION 014000 - QUALITY REQUIREMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

### 1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

## 1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: 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 conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

## 1.5 ACTION SUBMITTALS

A. Shop Drawings: For mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

## 1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data : For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

## 1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

C. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
3. Owner-performed tests and inspections indicated in the Contract Documents.

D. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

E. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and

inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

## 1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

**END OF SECTION 014000**

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

### 1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Contractor Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Contractor Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Contractor will pay electric-power-service use charges for electricity used by all entities for construction operations.

E. Contractor shall pay for all temporary electrical, water, and sewer services required for the project. Coordinate any tap fees, electrical service fees, and/or impact fees with local utility companies and local jurisdiction.

### 1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. HVAC system isolation schematic drawing.
2. Location of proposed air-filtration system discharge.
3. Waste handling procedures.
4. Other dust-control measures.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in 2018 NC Building Code, the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

**PART 2 - PRODUCTS**

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 12 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
3. Drinking water.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

**PART 3 - EXECUTION**

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

## 3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.

1. Provide additional telephone lines for the following:

a. Provide a dedicated telephone line for each facsimile machine in each field office.

2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

J. Electronic Communication Service: Project electronic documents and maintain electronic communications and the following:

1. Provide wireless in Construction trailer.

## 3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Project Acceptance inspection. Remove before Project Acceptance. Personnel remaining after Project Acceptance will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas.
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Provide temporary parking areas for construction personnel.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

G. Project Signs: Provide Project signs as indicated on Drawing A8.4. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.

2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

H. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. Temporary Elevator Use: See Section 142400 "Hydraulic Elevators" for temporary use of new elevators.

K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Project Acceptance.

## 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys each to Owner and Architect.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

## 3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

## 3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Project Acceptance.

E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Project Acceptance. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

**END OF SECTION 015000**

## SECTION 016000 - PRODUCT REQUIREMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

### 1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

### 1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

## 1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

**PART 2 - PRODUCTS**

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

## 2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 016000**

**SECTION 017300 - EXECUTION**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

### 1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

1. Contractor shall engage a Professional Locating Company to locate all private utilities within the construction area and also engage 811 for all public utilities.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

## 3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

## 3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

## 3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Project Acceptance.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

## 3.6 CUTTING AND PATCHING

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

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

## 3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Project Acceptance.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Project Acceptance.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

## 3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

## 3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Project Acceptance.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

**END OF SECTION 017300**

## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

## PART 1 - GENERAL

### 1.1 SUMMARY

A. The Work of this Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous construction waste.
2. Recycling nonhazardous construction waste.
3. Disposing of nonhazardous and waste.

### 1.2 DEFINITIONS

A. CMU: Concrete masonry units.

B. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

C. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

D. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.

E. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

F. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

G. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

### 1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

### 1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed. Plan must include the following:

1. Strategies to reduce the generation of waste during Project design and construction.
2. Waste diversion goals for Project, identifying the materials (both structural and nonstructural) targeted for recycling, reuse, or salvage and identifying the target diversion percentage (at least 50 percent).
3. Where materials will be taken, including expected diversion rates for each material.

1.5 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan in accordance with requirements in this Section. Plan must include provisions for waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Preparation of Waste: Prepare and maintain recyclable waste materials in accordance with recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to maximum extent practical in accordance with approved construction waste management plan.

### 3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cutoffs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in containers and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

D. Paint: Seal containers and store by type.

## 3.4 DISPOSAL OF WASTE

A. Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Unless otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning:

1. Do not burn waste materials.
2. Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

**END OF SECTION 017419**

## SECTION 017700 - CLOSEOUT PROCEDURES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Project Acceptance procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

### 1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Pre-Final.

### 1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Per State Construction Close-out List.

C. Certificate of Insurance: For continuing coverage.

D. Field Report: For pest control inspection.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

### 1.6 PRE-FINAL PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Pre-Final Inspection by Architect: Complete the following a minimum of 7 days prior to requesting Architect's Pre-Final inspection. List items below that are incomplete at time of request.

1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
4. Contractor's statement of completion with request for designer's Pre-Final inspection
5. Certificate of Occupancy by Local Authority Having Jurisdiction:
6. Installer's Fire Alarm System Record of Completion (Certification) as required by NFPA 72:
7. Installer's Sprinkler System Record of Material and Test Reports as required by:
    a. NFPA 13-(Sprinkler Systems)
    b. NFPA 14-(Standpipe and Hose Systems)
    c. NFPA 20-(Centrifugal Fire Pumps)
    d. Local Approval Letter of Sprinkler System Design
8. Dept. of Labor Approval for Elevator.
9. Dept. of Labor Approval for Boiler & Pressure Vessels
10. Domestic Water Test Report and Acceptance for Use:
11. Laboratory Hood Certification
12. Engineer's Approval of Test and Balance Report(TAB)
13. NEC Load Tests: Battery Powered Emergency Devices
14. Emergency Generator Load Test
15. Installer's Electrical Service Ground Test Report

C. Inspection: Submit a written request for Pre-Final inspection a minimum of 7 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.
3. A Final Inspection with State Construction will not be scheduled until the Contractor completes the punchlist items in particular all life-safety related items.

## 1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Complete all punchlist items from Pre-Final inspection.
2. Advise Owner of pending insurance changeover requirements.
3. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
5. Advise Owner of changeover in heat and other utilities.
6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
7. Complete final cleaning requirements, including touchup painting.

8. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Procedures Prior to Final Acceptance: Complete the following a minimum of 7 days prior to requesting State Construction inspection for determining date of Final Acceptance. List items below that are incomplete at time of request.

C. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.

1. State Construction, the Architect, and the Owner may accept the Project and issue a Project Acceptance Form for minor items. These items are to be completed within 30 days after acceptance. Failure to complete the outstanding items will necessitate issuance of a 15 notice by the Architect, after which the Owner may initiate completion of the outstanding items and withhold any costs incurred from the Contractor’s final payment request.

2. Reinspection: If the Project is not accepted, request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties effective the day after Project Acceptance.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

**PART 2 - PRODUCTS**

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

**PART 3 - EXECUTION**

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

A. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

**END OF SECTION 017700**

## SECTION 017823 - OPERATION AND MAINTENANCE DATA

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

### 1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

### 1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

    a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    b. Enable inserted reviewer comments on draft submittals.

2. One paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

C. Initial Manual Submittal: Submit draft copy of each manual at Pre-Final Inspection. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Project Acceptance and at least 7 days before commencing demonstration and training. Architect will return copy with comments.

## PART 2 - PRODUCTS

### 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### 2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.

8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

**PART 3 - EXECUTION**

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

**END OF SECTION 017823**

## SECTION 017839 - PROJECT RECORD DOCUMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

### 1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.

B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

## PART 2 - PRODUCTS

### 2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy.

## PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

**END OF SECTION 017839**

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Systems to be Commissioned:

1. HVAC.
2. Building Automation.
3. Domestic Hot Water.
4. Lighting Controls.

### 1.3 COMPENSATION

A. If Architect, Commissioning Authority, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.

1. Failure to provide timely notice of commissioning activities schedule changes.
2. Failure to meet acceptance criteria for test demonstrations.

### 1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Commissioning Authority.
2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning process.

## 1.5 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Plumbing, Mechanical, and Electrical Sections for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
2. Contractor personnel and subcontractors participating in each test.
3. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

F. Construction Checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

## 1.6 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:

a. Pre-startup reports.

b. Approved test procedures.
c. Test data forms, completed and signed.
d. Progress reports.
e. Commissioning issue report log.
f. Commissioning issue reports showing resolution of issues.
g. Correspondence or other documents related to resolution of issues.
h. Other reports required by commissioning process.
i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction-Phase Commissioning Process Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Bind report in three-ring binders.
2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
3. Record report on compact disk.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:

a. Test specification.
b. Pre-startup reports.
c. Approved test procedures.
d. Test data forms, completed and signed.
e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

A. Construction checklists cannot modify or conflict with the Contract Documents.

B. Create construction checklists based on actual systems and equipment to be included in Project.

C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.

1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
2. Included optional features.
3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
4. Installation Checks:

    a. Location according to Drawings and approved Shop Drawings.
    b. Configuration.
    c. Compliance with manufacturers' written installation instructions.
    d. Attachment to structure.
    e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
    f. Utility connections are of the correct characteristics, as applicable.
    g. Correct labeling and identification.
    h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.

E. Performance Tests:

1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.

F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify deferred construction checklists by number and title.

2. Provide a target schedule for completion of deferred construction checklists.
3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

## 3.3 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning process with the Construction Schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.
2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

## 3.4 SCHEDULE COORDINATION

1. Building Cleanliness, HVAC Start-Ups, Controls, TAB, and Cx Functional Testing: Contractor shall be responsible for providing an overall project schedule that provides the necessary time frames to complete Cx Functional Performance Testing prior to owner turnover/occupancy. Cx Functional Testing shall not begin until after all building / HVAC control systems are 100% complete and all field TAB work is 100% complete. Schedule shall be finalized with the understanding that completion of all HVAC controls and TAB work hinges upon the general building construction and cleanliness that will allow equipment to be operated continuously, on a daily basis.

2. AHU Start-Ups: Building must be relatively clean before starting up any AHU systems – no ongoing work that produces visible quantities of airborne dust. Units shall not be operated in any capacity until all drywall/sanding and floor grinding work is 100% complete. If field activities are observed that continue to generate dirt/dust after AHU start-ups, contractor shall be responsible for cleaning of ductwork and unit interiors.

3. Phased Equipment Start-Up: HVAC supply/ventilation air as well as building exhaust are both served by large, central systems that feed the entire building. Project does not allow for "phased" equipment start-ups where one floor at a time is "brought online". Entire building must be free of dust-producing activities before operating any central HVAC Equipment. This needs to be taken into account in the overall project schedule.

4. Temporary Conditioning: Contractor shall provide a plan for temporary heating/cooling if building conditioning is required but AHUs or building systems are not ready to operate, of if general building conditions/cleanliness does not allow for AHU operation.

5. AHUs During Construction: If the contractor requests that HVAC equipment be operational in order to prevent delays in project schedule, the GC shall request that the commissioning agent, design team, and owner inspect the status of ductwork and AHU cleanliness and grant permission to operate equipment. Contractor shall submit a written letter to accept responsibility for any duct/equipment cleaning that is required due to continued construction activity that continues to generate dust. HVAC contractor shall maintain temporary filter media to help keep ductwork, equipment, and coils clean, but use of filter media is not an acceptable "solution" to allow HVAC equipment to operate if general construction work continues to generate dirt and dust on a regular basis.

6. Start-Up Plan: As part of the submittal process, contractor shall submit a coordinated HVAC equipment / system start-up plan with input from the HVAC contractor, and controls contractor to outline all expectations for equipment start-up including, but not limited to, description of building cleanliness and overall interior construction status as a pre-cursor to start ups, order of start-up activities (by system and by area), what level of controls and equipment safeties shall be in place at time of start-ups, required locations of filter media on HVAC grilles and diffusers, filter media maintenance plan during construction, use of temporary smoke detectors to allow 24/7 AHU operation if required, and protocol for shutting down units as required based on construction activity.

7. AHU Operation – OA vs RA/Exhaust Air: HVAC start-up plan as well as completion schedule shall include specific differentiation between operating AHUs at 100% outdoor air versus allowing AHUs to pull return air or exhaust air from the space. Buildings are often not clean enough to pull return air at the time that contractors wish to start operating AHUs. For any time period that units are to operate at 100% outdoor air, Exhaust Air duct openings and grilles shall remain fully covered in plastic until the owner, design team, and Cx agent agree that the building is clean enough to pull exhaust air air. For time period of 100% OA operation, contractor(s) shall consider necessary precautions for freeze protection and proper temp/humidity control associated with 100% OA.

8. Fire/Smoke Dampers & AHU Start-Up: Contractor HVAC start-up plan shall include intended approach to ensure that fire/smoke dampers are open throughout the building at time of AHU start-ups. Fire/smoke dampers are powered open through the fire alarm panel and the FACP may not be active/complete at the time of AHU start-ups. Outline provisions to provide temporary power to open all fire/smoke dampers before start-ups. Acceptable means of opening dampers to allow AHU start-ups shall NOT include disconnecting damper linkages to manually open the fire/smoke dampers.

9. Schedule – AHU Operation: Contractor's initial schedule shall be required to include a date that the building will be clean enough to operate AHUs on a daily basis, to allow uninterrupted work on these systems by both controls and TAB contractor. This date shall be directly linked to the final project turnover date, with the understanding that failure to achieve this date will push back the turnover date. Contractor shall determine what month of the year that AHUs will be required to operate on a daily basis to meet project schedule and plan in advance for whether or not Heating Hot Water or Chilled Water systems (or both) will need to be functional before operating AHUs.

10. Substantial Completion FOR CX: "Substantial Completion for Cx" shall be defined as follows: All BAS, Controls, Fire Alarm, and Test & Balance work 100% complete for all primary systems & equipment – AHUs, HHW System, Terminal Units, and Exhaust Fans.

11. For the BAS this shall include all programming, sequences, BAS graphics & floor plans, alarm set up, BAS trend points set up, occupancy schedules in place, and all set points finalized.

12. For Test & Balance this shall mean that all field TAB work is complete, AHUs have been finalized, all devices calibrated, exhaust systems complete, +/- pressurization rooms verified, and draft TAB report has been turned over to System WorCx

13. For Electrical, this means that all fire alarm testing is 100% complete. Fire/Smoke dampers are operational, AHU shut-downs in place, and under control of FACP.

14. Schedule – Cx Testing: Cx testing shall begin upon contractor(s) meeting all requirements for "Substantial Completion for Cx". For this specific project, the schedule shall provide six (6) weeks between Substantial Completion for Cx and turnover of the building to the owner for occupancy. This will provide time for all Cx Functional testing as well as resolution of issues and re-testing of systems as necessary – including smoke control systems.

15. Building Automation System, Building Pressurization, Occupancy Sensors, and Unoccupied Mode: Within the six (6) week Cx functional testing window, contractor shall also ensure two (2) weeks of time that the building is accessible solely to CxA or subcontractors specifically requested by CxA to assist in functional testing. Portions of Cx testing referenced above become entirely compromised if any other parties are performing work in ANY areas of the building. This (2) week window shall be provided in the middle of the larger 6-week testing window.

16. BAS & Building Network:Construction schedule and Substantial Completion for Cx shall be coordinated with building network to ensure that the BAS is fully integrated to the existing network and server at the start of Cx Functional Testing.

17. Schedule Ties: Contractor schedule shall include ties between building clean, HVAC start-ups, controls completion, Test & Balance work, Substantial Completion for Cx, and building turnover to clearly outline that failure to meet any one of those dates has a direct impact on ability to achieve the final turnover date. Note that systems must be up and running on a daily basis for the BAS contractor to get them under control and perform internal checkouts. Systems must be under control before TAB can begin work on each system. TAB work must be complete prior to Cx functional testing. There schedule overlap between these three activities is very minimal.

18. Schedule & Change Orders: Contractor shall be responsible to evaluate the effect that any change order may have on the individual schedule milestones for building cleanliness, HVAC, Controls, TAB or Cx. If a change order is believed to impact any of these dates, owner shall be made aware and the building turnover date shall be adjusted accordingly. (Unless contractor coordinates with all trades to determine an agreed upon approach for overtime work to make up schedule days). At no point shall the contractor attempt to shorten the duration or number of days provided to complete BAS/Controls, TAB, or Cx Testing as a means of recovering schedule days.

19. TAB Start Requirements: Contractor schedule start date for TAB activities shall be appropriately linked to HVAC, Start-Up, and Controls schedule dates to ensure that entire systems are ready to TAB work to commence.

20. Air Side TAB: Shall not begin until corresponding AHU is under proper static pressure control, all spaces are free dirt/dust, all connected VAV boxes have been energized and are under control, all ceiling grid and diffusers are in place.

21. TAB Support / Coordination: For any areas of the building that require a lift to access ductwork or volume dampers for TAB work, contractor shall provide and coordinate lift for use by TAB contractor.

## 3.5 COMMISSIONING TESTING

A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.

C. Construction Checklists:

1. Complete construction checklists as Work is completed.
2. Distribute construction checklists to installing contractors before they start work.
3. Installers:

    a. Verify installation using approved construction checklists as Work proceeds.

4. Provide Commissioning Authority access to construction checklists.

D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

F. Test Procedures and Test Data Forms:

1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
3. Completed test data forms are the official records of the test results.
4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
5. Review preliminary test procedures and test data forms, and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:

    a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
    b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.

6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:

I. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:

J. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.

4. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.

5. Retest:

a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are

determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.

b. For each repeated test demonstration, submit a new test data form, marked "Retest."

6. Do not correct commissioning compliance issues during test demonstrations.

## 3.6 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

1. Construction Checklists:

a. Material checks.
b. Installation checks.
c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
d. Performance Tests:

1) Static tests, as appropriate.
2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
3) Equipment and assembly performance tests.
4) System performance tests.
5) Intersystem performance tests.

2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.

C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

## 3.7 SCHEDULING

A. Commence commissioning process as early in the construction period as possible.

B. Two-Week Look-Ahead Commissioning Schedule:

1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

## 3.8 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:

    a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
    b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
    c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
    d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
    e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.

2. Test data reports include the following:

    a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
    b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
    c. Signatures of individuals performing and witnessing tests.
    d. Data trend logs accumulated overnight from the previous day of testing.

3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:

    a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
    b. Action distribution list.
    c. Report date.
    d. Test number and description.
    e. Equipment identification and location.
    f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
    g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
    h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
    i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.

j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:

a. Completed data forms.
b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
c. Activities scheduled but not conducted per schedule.
d. Commissioning compliance issue report log.
e. Schedule changes for remaining Commissioning-Process Work, if any.

5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.

a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
b. Attach to the data form printed trend log data collected during the test or test demonstration.
c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.

6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

## 3.9 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Architect the attached signed “Certificate of Readiness” and include a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning process.

B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Substantial Completion FOR Cx" Paragraph in the "Schedule Coordination" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction-phase commissioning process completion.

C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.

D. When construction-phase commissioning process or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of project Acceptance.

CERTIFICATE OF READINESS

Contractor has verified that the following prerequisite items have been completed in preparation for the functional testing phase of the commissioning process.

System to Be Commissioned: _____

☐ The system to be commissioned, including all equipment, ductwork, piping, electrical, plumbing, and interfaces to other systems is complete, installed per the Contract Documents, and any issues previously identified by the Commissioning Team have been addressed.

☐ All equipment has been properly started up by qualified personnel. Where specified, the startup was conducted by the manufacturer. Startup procedures and reports have been documented and provided to the CxA.

☐ For HVAC systems, all duct pressure testing, duct cleaning, pipe pressure testing, and pipe flushing has been completed according to the Contract Documents.

☐ For HVAC systems, the Test and Balance work is complete, all issues have been corrected, and a final (draft) report has been provided to the CxA.

☐ For Building Automation system (BAS), the BAS contractor has completed their own checkout procedures, including but not limited to the following:

- Calibration of all sensors.
- Point-to-Point checks of all sensors and devices.
- Checks of all devices (dampers, control valves, etc.) for proper operation, fail position, and verification of no leakage.
- Programming of all sequences of operations, alarms, and setpoints.
- Completion and check of all graphics.
- Interface with other systems (lighting, plumbing, metering, etc.).

☐ All equipment and systems are online and operating with no restrictions for testing.

☐ All necessary notifications, coordination and scheduling have been considered that might be required for functional testing of this system (e.g. Owner, Fire Marshall, Occupants, etc.).

*Attach a list any known exceptions or outstanding issues related to the above statements.*

List name, title, company, date: _____

I have verified that the above statements are true and that the system is ready for functional testing by the CxA, except for those items noted as attached. I understand that if it is found that the system has not been properly prepared as per the above, necessitating one or more return site visits by the CxA, the Construction Team may be charged by the Owner for the CxA's additional time, including travel time plus travel expenses.

**Signature: _____**

**END OF SECTION 019113**

**SECTION 033000 - CAST-IN-PLACE CONCRETE**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.
5. Concrete toppings.
6. Building frame members.
7. Building walls.

B. Related Sections:

1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
2. Section 321313 "Concrete Paving" for concrete pavement and walks.

### 1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Waterstops.
10. Semi-rigid joint filler.
11. Joint-filler strips.
12. Repair materials.

C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Preinstallation Conference: Conduct conference at Project site.

1. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

**PART 2 - PRODUCTS**

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars (weldable): ASTM A 706/A 706M, Grade 60 deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/ II . Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94 and potable.

## 2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.5 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513,for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Ribbed with center bulb.
2. Dimensions: 4 inches by 3/16 inch thick; nontapered.

## 2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A, not less than 15 mils thick. . Include manufacturer's recommended adhesive or pressure-sensitive tape.

## 2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

## 2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

A. Cementitious Materials: Percentages in subparagraphs below repeat ACI 301 limits for concrete exposed to deicing chemicals.

B. Percentages in subparagraphs below repeat ACI 301 limits for concrete exposed to deicing chemicals. Revise to suit Project.

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.

## 2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 5 inches plus or minus 1 inch.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Minimum Water-Cementious Materials Ratio: 0.45
3. Minimum Cementitious Materials Content: 520 lb/cu. yd.
4. Slump Limit: 4 inches, plus or minus 1 inch; or 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Air Content for exterior concrete: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
6. Air Content for interior slabs: Do not allow air content of trowel-finished floors to exceed 3 percent.

C. Interior Suspended Slabs: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementious materials ratio 0.45.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd.

4. Slump Limit: 4 inches, plus or minus 1 inch; or 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture at Project site.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
6. Limit water-soluble chloride ion content in hardened concrete to .15 percent by weight of cement.

2.11 FABRICATING REINFORCEMENT

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

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

**PART 3 - EXECUTION**

3.1 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges." “Wet Setting” anchor rods is not permitted.

3.2 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

## 3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least into concrete.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

## 3.5 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions and as follows:
1. Locate waterstops in center of joint unless otherwise indicated on Drawings
2. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size.
3. Secure waterstops in correct position at 12 inches on center.
4. Field fabricate in accordance with manufacturer's instructions using heat welding.
    a. Miter corners, intersection, and directional changes in waterstops.
    b. Align center bulbs.
5. Clean waterstops immediately prior to placement of concrete.

6. Support and protect exposed waterstops during progress of the Work.

## 3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## 3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

## 3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces **to receive trowel finish**.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

## 3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

## 3.10 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

## 3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

## 3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.

a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

## 3.13 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

**END OF SECTION 033000**

**SECTION 042000 - UNIT MASONRY**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Clay face brick.
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry-joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:
   1. Decorative CMUs, in the form of small-scale units.
   2. Clay face brick, in the form of straps of five or more bricks.
   3. Weep holes/cavity vents.

D. Samples for Verification: For each type and color of the following:

   1. Exposed CMUs.
   2. Clay face brick, in the form of straps of five or more bricks.
   3. Special brick shapes.
   4. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
   5. Cavity vents.
   6. Accessories embedded in masonry.

E. Sustainable Design Submittals: For items noted in body of specification.

1.6 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

   1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

   1. Masonry units.
      a. Include material test reports substantiating compliance with requirements.
      b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include name of manufacturer, brand name, and type.
   3. Mortar admixtures.
   4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   5. Grout mixes. Include description of type and proportions of ingredients.
   6. Reinforcing bars.
   7. Joint reinforcement.
   8. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and

resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 SPECIAL REQUIREMENTS

A. The Work of this Section shall be bid and provided as a single lump sum subcontract to the General Contractor (Square foot/ unit pricing of masonry labor and General Contractor furnished materials is not permitted). The Masonry Subcontractor shall be a firm, who specializes in masonry construction and shall furnish all materials, equipment, and labor required to complete the required masonry construction for this project.

B. Lump Sum Masonry Contractors through the General Contractor, shall upon request of the Architect/ Owner provide evidence of at least 5 years experience with 5 projects of equivalent size and scope of experience performing work as a Lump Sum Masonry Contracting Firm.

C. Masonry subcontractor shall not act as a broker, but shall perform the Work of this section with its own forces. Upon request of the Architect, General Contractor shall provide a copy of the Contract between General Contractor and Masonry Subcontractor (contract amounts may be omitted) indicating their contract is a lump sum contract.

D. Additionally, the work of this section shall be bid and performed by a firm certified as a "North Carolina Masonry Contractors Association Certified Masonry Contractor" as described in the most current version of the NCMCA's "Guide to Masonry Contractor Certification." (North Carolina Masonry Contractors Association, PO Box 3463, Hickory, NC 28603-3463, (828) 324-1564, information@ncmca.com) . The masonry subcontractor shall at all times when work is in progress, provide an individual from its own staff designated by the North Carolina Masonry Contractors Association Masonry Contractor Certification Program as a "CMP-Certified Masonry Professional" or "CME-Certified Masonry Executive" (as described in the most current version of the NCMCA's "Guide to Masonry Contractor Certification") on-site to supervise work in progress.

E. Definition: Lump Sum Masonry Subcontractor shall be a firm specializing in lump sum masonry contracting work and shall have been in masonry construction business for at least 5 years. Sub-contracting of masonry work is discouraged and if allowed the masonry subcontractor shall be responsible for the performance of its subs and shall continually supervise and inspect their work. The masonry subcontractor shall have a superintendent and crew chiefs (from its own staff) on site supervising all the masonry work.

1. A listing of masonry contractors capable of providing a lump sum bid is available from the North Carolina Masonry Contractor's Association at 828-324-1564 (828-324-2179, fax) or on the Internet at www.ncmca.com.

F. Daily preliminary cleaning of masonry is required for this project. The masonry subcontractor shall provide a person(s) to perform this task daily.

G. If final cleaning of the masonry is to be subcontracted, the masonry subcontractor shall be responsible to supervise the cleaning operations, coordinate the type and application of cleaning materials in accordance with specific manufacturer's written recommendations. Masonry subcontractor shall certify to the Owner through the Architect that the proper cleaners were used, at the proper application rates, and complied with manufacturer's recommendations.

## 1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for each type of exposed unit masonry construction in sizes approximately 60 inches long by 60 inches high by full thickness, including face and backup wythes and accessories.
    a. Include a sealant-filled joint at least 16 inches long in each mockup.
    b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
    c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
    d. Include metal studs, sheathing, water-resistive barrier sheathing joint-and-penetration treatment, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
    e. Include clay face brick on one face of interior unit masonry wall mockup.
2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.10 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### 2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

## 2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

## 2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
2. Density Classification: Lightweight unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: All exposed interior CMU units, including mechanical rooms, stairwells, etc. are to be 8x8 scored units.

C. Decorative CMUs: ASTM C90, lightweight.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Echelon Masonry; Polished face; full range (Basic of Design)
b. Johnson Concrete Products; Prestige Series.
c. Mutual Materials
d. Nitterhouse Masonry Products.

2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
4. Pattern and Texture: Standard pattern, ground-face polished finish.
5. Colors: As selected by Architect from manufacturer's full range.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

## 2.5 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## 2.6 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C 216.

1. Grade: MW or SW.
2. Type: FBX.
3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4150 psi.
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Size (Actual Dimensions): 3-5/8 inches wide by 2-2/3” inches high by 7-5/8 inches long.
7. Application: Use where brick is exposed unless otherwise indicated.
8. Color and Texture selected by Architect from full range of smooth face red/browns for field brick, light range for accents. Subject to compliance with requirements, provide face brick by one of the following:

    a. Belden

    b. Boral

    c. Glen-Gery.

## 2.7 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Cement: ASTM C 1329/C 1329M.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.

G. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C 404.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

J. Water: Potable.

## 2.8 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Wire Size for Veneer Ties: 0.187-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

E. Masonry-Joint Reinforcement for Multiwythe Masonry:

1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

## 2.9 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
2. Where wythes are of different materials, use adjustable ties with heavy-duty flattened errated pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
3. Wire: Fabricate from 1/4-inch-diameter, hot-dip galvanized steel wire

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch-diameter, hot-dip galvanized steel wire.

E. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated] [bent to configuration indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M] [Epoxy coating 0.020 inch thick.

## 2.10 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
7. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
8. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
9. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
10. Solder metal items at corners.

A. Flexible Flashing: Use the following unless otherwise indicated:

1. Laminated Stainless Steel Fabric Flashing. Non-Asphaltic: Use the following unless otherwise indicated:
2. Stainless steel core with polymer fabric laminated to stainless steel face with non-asphaltic adhesive. Stainless steel type: 304, ATM A167. Fabric: polymer fabric; laminated back face of stainless steel core.

    a. Products: Subject to compliance with requirements, provide the following:
        1) York Manufacturing, Inc.; Multi-Flash SS
        2) STS Coatings, Inc.; Gorilla Flash Stainless Fabric
        3) Illinois Products, Inc.; IPCO Stainless Steel Fabric Flashing
        4) TK Products, Inc.; TK TWF
    b. Accessories: Form the stainless steel flashing in the field or use 26 gauge stainless steel pre-manufactured corners

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is fully concealed, use metal flashing and flexible flashing as detailed.

C. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. Termination Bars for Flexible Flashing: Stainless-steel sheet 0.019 inch by 1-1/2 inches with a 3/8 inch sealant flange at top.

## 2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from urethane.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:

1. Vinyl Weep Hole/Vent (For use in Brick Veneer): Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.
2. Rectangular Plastic Weep/Vent Tubing (For use in Decorative CMU): Clear butyrate, 3/8 by 1-1/2 by 3-1/2 incheslong.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Configuration: Provide one of the following:
   a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.

## 2.12 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

## 2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.

3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type S.

D. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Mix to match Architect's sample.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:
   a. Cast-stone trim units.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2500 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

## 3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

## 3.4 LAYING MASONRY WALLS

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

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
   3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

## 3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
   5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

F. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, and air barriers unless otherwise indicated.

## 3.6 CAVITY WALLS

A. Bond wythes of cavity walls together as follows:

1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use tab-type reinforcement.

2. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

## 3.7 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Embed connector sections and continuous wire in masonry joints.
2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 18” inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

B. Provide not less than 2 ¼ inches of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

## 3.8 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

## 3.9 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 2 inches wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

## 3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.

C. Form expansion joints in brick as follows:

1. Build in compressible joint fillers where indicated.
2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
3. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
7. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

E. Install cavity vents at 16 inches on center in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

## 3.13 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

## 3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

## 3.15 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

E. Alternative Allowable Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick using Pressurized Water Cleaning method described in BIA Technical Notes 20
    a. Use a stainless steel 25 to 50 deg. fan tip, held a minimum of 12 in. (305 mm) from the brick surface
    b. Do not use water pressures higher than 400 psi as measured at the nozzle tip unless
    c. For pre-wetting, use very low pressure (less than 100 psi)
    d. Saturate the area to be cleaned and brickwork below prior to applying cleaning solution, and keep wet until final rinse
    e. Apply cleaning solution according to manufacturer’s written directions instructions by brush or a chemical pump/tank sprayer with a wide-angle fan-shaped sprayer nozzle tip, maximum 30 to 50 psi.
    f. For rinsing, use low pressure 400 psi maximum.
    g. If contractor fails to comply with any of the above requirements, revert to Bucket and Brush Method only.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.16 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

**END OF SECTION 042000**

## SECTION 051200 - STRUCTURAL STEEL FRAMING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Field-installed shear connectors.
3. Grout.

### 1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

### 1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Shear stud connectors.
4. Shop primers.
5. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

## 1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using AISC 360.
2. Use Allowable Stress Design.

### 2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M .

B. Channels, Angles ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M .

D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade C, structural tubing.

E. Welding Electrodes: Comply with AWS requirements.

### 2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

C. Headed Anchor Rods: ASTM F 1554, Grade 36 weldable, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain.

### 2.4 PRIMER

A. Primer: SSPC-Paint 25, Type II, zinc oxide, alkyd, linseed oil primer.

B. Galvanizing Repair Paint: ASTM A 780/A 780M.

## 2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Galvanized surfaces.
4. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

## 2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize exterior steel located in exterior walls.

## 2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

### 3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Erection of Category AESS 3:
1. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
2. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
3. Remove weld spatter, slivers, and similar surface discontinuities.
4. Grind off butt and plug weld projections larger than 1/16 inch.
5. Continuous welds are to be of uniform size and profile.

6. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
7. Splice members only where indicated on Drawings.
8. No torch cutting or field fabrication is permitted.
9. Weld profiles, quality, and finish are be as approved by Architect.
10. Make joint welds, including tack welds, appear continuous

E. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

F. Splice members only where indicated.

G. Do not use thermal cutting during erection.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

## 3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

## 3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

## 3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

**END OF SECTION 051200**

**SECTION 052100 - STEEL JOIST FRAMING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. LH-series long-span steel joists.
3. Joist accessories.

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
1. Design special joists to withstand design loads with live-load deflections no greater than the following:
a. Roof Joists: Vertical deflection of **1/240** of the span.

2.2 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists.

B. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

C. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements **as indicated.**

1. Top-Chord Arrangement: **Pitched, two ways** to match roof slope.

B. Camber long-span steel joists **according to SJI's "Specifications**.

C. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.5 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

C. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

D. Welding Electrodes: Comply with AWS standards.

E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.6 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2.

B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications" and joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

## 3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

E. Perform additional testing to determine compliance of corrected Work with specified requirements.

## 3.4 PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists**, bearing plates, abutting structural steel,** and accessories.

1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
2. Apply a compatible primer of same type as primer used on adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

**END OF SECTION 052100**

**SECTION 053100 - STEEL DECKING**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

### 1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

D. Evaluation Reports: For steel deck, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members".

2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40, G90 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.

2.3 COMPOSITE FLOOR DECK

A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI C, with the minimum section properties indicated, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: As indicated.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile **indicated**.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Galvanizing Repair Paint: ASTM A 780.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

J. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

## 3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: As indicated.
2. Weld Spacing: As indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals as indicated and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

## 3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
3. Weld Spacing: Space and locate welds as indicated.
4. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches with end joints as follows:

1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

## 3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

## 3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 053100**

**SECTION 054000 - COLD-FORMED METAL FRAMING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Exterior non-load-bearing wall framing.
2. Roof rafter framing.
3. Soffit framing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Test Reports: For each listed product, for tests performed by **a qualified testing agency**.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

C. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

2.2 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: As indicated.
3. Section Properties: As indicated.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch
2. Flange Width: 1-1/2 inches .

C. Vertical Deflection Clips: Manufacturer's standard **bypass** or **head** clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: 1 inch plus the design gap for one-story structures.

## 2.3 ROOF JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0677 inch.
2. Flange Width: 1-5/8 inches, minimum.
3. Section Properties: As indicated.

## 2.4 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-5/8 inches, minimum.

## 2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

## 2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

D. Welding Electrodes: Comply with AWS standards.

2.7 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

## 3.3 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.
2. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.

2. Connect vertical deflection clips to bypassing studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

a. Install stud bridging at 4’-0” vertically below top bridging for Single Deflection Track.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

## 3.4 ROOF JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated**.** Fasten bridging at each joist intersection as follows:

1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

## 3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

## 3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 054000**

**SECTION 055000 - METAL FABRICATIONS**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Shelf angles.
5. Steel ladders.
6. Metal bollards.
7. Metal downspout boots.
8. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.3 COORDINATON

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Metal nosings and treads.
3. Paint products.

4. Grout.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Shelf angles.
5. Metal bollards.
6. Metal downspout boots.
7. Loose bearing and leveling plates for applications where they are not specified in other Sections.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

E. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

F. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

## 2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

B. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

## 2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 incheso.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## 2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.8 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch-diameter, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.

7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
8. Support each ladder at top and bottom and not more than 60 incheso.c. with welded or bolted steel brackets.
9. Galvanize and prime ladders, including brackets.

## 2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime exterior miscellaneous steel trim.

D. Prime miscellaneous steel trim with zinc-rich primer.

## 2.10 METAL BOLLARDS

A. Fabricate metal bollards from Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

B. Stainless steel finish.

## 2.11 METAL DOWNSPOUT BOOTS

A. Provide downspout boots made from cast aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

1. Outlet: Vertical, to discharge into pipe.

## 2.12 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with zinc-rich primer.

## 2.13 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inchesunless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

## 2.14 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.15 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## 2.16 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Other Items: SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

## 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions and overhead doors securely to, and rigidly brace from, building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

## 3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

## 3.4 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

## 3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mildry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

**END OF SECTION 055000**

## SECTION 055113 - METAL PAN STAIRS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

### 1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs, railings, and guards.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

D. Schedule installation of railings and guards so wall attachments are made only to completed walls.

1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

### 1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

### 1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

B. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

C. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to ASCE/SEI 7.

## 2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.

## 2.3 ABRASIVE NOSINGS

A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
2. Provide solid-abrasive units without ribs.
3. Nosings, Square-Back Units: 3 inches wide, without lip.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

## 2.4 FASTENERS

A. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.5 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

D. Prefilled Concrete Treads:

1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi and maximum aggregate size of 1/2 inch unless otherwise indicated.
2. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated on Drawings.
3. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.

a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

E. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

## 2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs, railings, and guards in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

## 2.7 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Service Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Stringers: Fabricate of steel channels as indicated on Drawings.

   a. Stringer Size: As indicated on Drawings.
   b. Provide closures for exposed ends of channel and rectangular tube stringers.
   c. Finish: Shop primed.

2. Platforms: Construct of steel plate or steel channel headers and miscellaneous framing members as indicated on Drawings.

   a. Provide closures for exposed ends of channel and rectangular tube framing.
   b. Finish: Shop primed.

3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
2. Steel Sheet, Uncoated: Cold-rolled steel sheet.
3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
5. Shape metal pans to include nosing integral with riser.

6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

    a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

## 2.8 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

B. Welded Connections: Fabricate railings and guards with welded connections.

1. Cope components at connections to provide close fit, or use fittings designed for this purpose.
2. Weld all around at connections, including at fittings.
3. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
4. Obtain fusion without undercut or overlap.
5. Remove flux immediately.
6. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint as shown in NAAMM AMP 521.

C. Form changes in direction of railings and guards as follows:

1. As detailed.

D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing and guard members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

G. Connect posts to stair framing by direct welding unless otherwise indicated.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.

a. Clean bottom surface of plates.
b. Set plates for structural members on wedges, shims, or setting nuts.
c. Tighten anchor bolts after supported members have been positioned and plumbed.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

## 3.3 INSTALLATION OF RAILINGS AND GUARDS

A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
4. Secure posts, rail ends, and guard ends to building construction as follows:

a. Anchor posts to steel by welding to steel supporting members.
b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as required to comply with performance requirements.

## 3.4 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

**END OF SECTION 055113**

## SECTION 055213 - PIPE AND TUBE RAILINGS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.

### 1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

### 1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of connecting and finishing members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified NC Professional Engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

F. Evaluation Reports: For post-installed anchors , from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified NC Professional Engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F.

## 2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

## 2.3 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

## 2.4 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

## 2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

## 2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inchunless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form Changes in Direction as Follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.

J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inchor less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide steel sleeves not less than 6 incheslong with inside dimensions not less than 1/2 inchgreater than outside dimensions of post, with metal plate forming bottom closure.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

## 2.7 STEEL AND IRON FINISHES

A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

### 3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

## 3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

## 3.6 ADJUSTING AND CLEANING

A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

## 3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Project Acceptance.

**END OF SECTION 055213**

## SECTION 055813 - COLUMN COVERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes snap-together metal column covers.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for column covers.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrorlike stainless-steel finish statuary conversion coating copper-alloy finish to include in maintenance manuals.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

## PART 2 - PRODUCTS

### 2.1 SNAP-TOGETHER COLUMN COVERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ATAS International, Inc.
2. Fry Reglet Corporation.
3. Hi-Tech Metals, Inc.
4. MM Systems Corporation.
5. Metal Sales & Service, Inc.

6. Pittcon Industries.

B. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.

1. Aluminum Sheet: ASTM B209, with not less than strength and durability properties of Alloy 5005-H32, 0.063 inch thick.

a. Finish: Clear anodic.

2. Column covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
3. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
4. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
5. Form returns at vertical joints to provide hairline V-joints.
6. Form returns at vertical joints to provide 1/2-inch-wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals 1/2 inch deep.
7. Form returns at vertical joints to accommodate backer rod and sealant.
8. Fabricate column covers with hairline horizontal V-joints produced by forming returns on mating ends of column cover sections. Locate horizontal joints as indicated.
9. Fabricate column covers without horizontal joints.
10. Fabricate column covers with horizontal butt joints, tightly fitted and backed with a sleeve for field splicing with adhesive.
11. Fabricate column covers with 1/2-inch-wide reveals at horizontal joints produced by forming returns on mating ends of column cover sections. Provide snap-in metal filler strips at reveals matching reveals at vertical joints. Locate horizontal joints as indicated.
12. Fabricate base and ceiling ring to match column covers.
13. Fabricate with calk stop/stiffener ring.
14. Apply manufacturer's recommended sound-deadening insulation to backs of column covers.

## 2.2 MISCELLANEOUS MATERIALS

A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work unless exposed fasteners are unavoidable or are the standard fastening method.
2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

B. Sound-Deadening Materials:

1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C665, Type I, and passing ASTM E136 test.

C. Backing Materials: Provided or recommended by column cover manufacturer.

2.3 FABRICATION, GENERAL

A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.

2.4 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

## 3.3 ADJUSTING AND CLEANING

A. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

## 3.4 PROTECTION

A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Project Acceptance.

**END OF SECTION 055813**

## SECTION 057313 - GLAZED DECORATIVE METAL RAILINGS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Glazed decorative metal railings.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.

### 1.2 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor and exterior deck areas and for pedestrian guidance and support, visual separation, or wall protection.

### 1.3 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.5 ACTION SUBMITTALS

A. Product Data:

1. Metal railings assembled from standard components.
2. Glass products.
3. Glazing cement and accessories for structural glass railings.
4. Sealant and accessories for structural glass railings.
5. Fasteners.
6. Wood rails.
7. Lacquer for copper alloys.
8. Shop primer.
9. Bituminous paint.
10. Nonshrink, nonmetallic grout.

11. Anchoring cement.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Base channel.
3. Each type of glass and glass edge required.
4. Fittings and brackets.
5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, structural glass balusters, and glass-infill panels. Show method of finishing members at intersections. Samples need not be full height.

E. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

C. Product Test Reports: For tests performed by a qualified testing agency, in accordance with ASTM E894, ASTM E935, ASTM E2353, and ASTM E2358.

D. Evaluation Reports: From ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1. For glazed decorative metal railings.
2. For post-installed anchors.

E. Preconstruction test reports.

## 1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups as indicated on Drawings.
2. Build mockups for each form and finish of glass-infill panel railing consisting of two posts, top rail, handrail, glass-infill panel, and anchorage system components that are full height and are not less than 24 inches in length.

3. Build mockups for each form and finish of structural glass railing consisting of top rail, structural glass, base channel, and anchorage system components that are full height and are not less than 24 inches in length.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Glazed decorative metal railing manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed decorative metal railings, including attachment to building construction.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Stainless Steel: 60 percent of minimum yield strength.
2. Steel: 72 percent of minimum yield strength.
3. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA CW-12, "Structural Properties of Glass."

C. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.

c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Structural Glass Railings and Glass-Infill Panels:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

3. For structural glass railings, support each section of top rail and handrail by a minimum of three glass panels or by other means so railings will remain in place if any one glass panel fails.

a. Support top rail and handrail ends such that railings remains in place if end glass panel fails.

## 2.2 MANUFACTURERS

A. Stainless-Steel Decorative Railings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Architectural Railings & Grilles, Inc.
b. Blum, Julius & Co., Inc.
c. P & P Artec.
d. Wagner, R & B, Inc.
e. Wylie Systems.

B. Source Limitations for Laminated Glass: Obtain from single source from single manufacturer.

C. Source Limitations for Decorative Metal Railing Components: Obtain from single source from single manufacturer for each component and installation method.

D. Product Options: Information on Drawings and in the Specifications establishes requirements for railing system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

## 2.4 STAINLESS STEEL

A. Tubing: ASTM A554, Grade MT 304.

B. Pipe: ASTM A312/A312M, Grade TP 304.

C. Castings: ASTM A743/A743M, Grade CF 8 or Grade CF 20.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A666 or ASTM A240/A240M, Type 304.

E. Bars and Shapes: ASTM A276, Type 304.

## 2.5 GLASS AND GLAZING PRODUCTS, GENERAL

A. Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA/GANA Publications: "GANA Laminated Glazing Reference Manual" and "GANA Glazing Manual."

B. Safety Glazing: Glazing is to comply with 16 CFR 1201, Category II.

C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label is to indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

D. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Class 1 and low-iron clear, or Class 2 (tinted) as indicated, Quality-Q3.

E. Glazing Cement and Accessories for Structural Glass Railings: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.

F. Glazing Gaskets for Glass-Infill Panels: Glazing gaskets and related accessories as recommended or supplied by railing manufacturer for installing glass-infill panels in post-supported railings.

## 2.6 GLASS HANDRAILS AND GUARDS

A. Tempered Glass Handrails and Guards: Provide products that have been tested for surface and edge compression in accordance with ASTM C1048 and for impact strength in accordance with 16 CFR 1201 for Category II materials.

1. Glass Color: Clear.
2. Thickness: Not less than ½-inch minimum as determined by structural loads.

## 2.7 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless Steel Components: Type 304 stainless steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/ASTM F1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.8 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast stainless steel, center of rail 2-1/2 inches from face of structural glass balusters.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Anchoring Cement: provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.9 FABRICATION OF METAL RAILINGS

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

H. Form changes in direction as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.

I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of hollow railing members with prefabricated end fittings.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

M. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.10 FABRICATION OF GLASS PANELS AND BALUSTERS

A. Fabricate glass to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

B. Glass-Infill Panels: Provide tempered glass-infill panels.

1. Edge Finish: Clean-cut or flat-grind edges to produce smooth, square edges with slight chamfers at junctions of edges and faces.

## 2.11 METAL FINISH REQUIREMENTS, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.12 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
3. Polished and Buffed Finish: 320-grit finish followed by buffing to a high luster finish.

D. Stainless Steel Sheet, Strip, Plate, and Bar Finishes:

1. High Luster Finish: ASTM A480/A480M, No. 7.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

A. Comply with Drawings and manufacturer's written instructions for installing glazed decorative metal railings, accessories, and other components.

B. Perform cutting, drilling, and fitting required for installing metal railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of metal railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.2 METAL RAILING CONNECTIONS

A. Nonwelded Connections:

1. Use mechanical or adhesive joints for permanently connecting railing components.
2. Use wood blocks and padding to prevent damage to railing members and fittings.
3. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Expansion Joints: Install expansion joints at locations indicated, but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

### 3.3 METAL ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted in sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, attached to post with setscrews.

D. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

## 3.4 INSTALLATION OF GLASS BALUSTERS

A. Post-Supported Railings with Glass-Infill Panels:

1. Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles.
2. Erect posts and other metal railing components, and set factory-cut glass-infill panels.
3. Do not cut, drill, or alter glass-infill panels in field. Protect edges from damage.

## 3.5 CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Project Acceptance.

## 3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION 057313**

**SECTION 061000 - ROUGH CARPENTRY**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Wood sleepers.
3. Plywood backing panels.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.7 QUALITY ASSURANCE

A. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

**PART 2 - PRODUCTS**

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.5 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

**PART 3 - EXECUTION**

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locatenailers, blocking,and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

C. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

D. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use copper naphthenate for items not continuously protected from liquid water.

E. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

## 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

## 3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION 061000**

**SECTION 061600 - SHEATHING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Parapet sheathing.
3. Sheathing joint and penetration treatment.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations of air-barrier sheathing assembly.

a. Coordinate construction of mockups to permit inspection and testing of sheathing before external insulation and cladding are installed.
b. Include junction with roofing membrane, building corner condition.
c. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Project Acceptance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Type and Thickness: Type X, 5/8 inch thick.
2. Size: 48 by 96 inches for vertical installation.

2.3 PARAPET SHEATHING

A. Plywood Sheathing: , Exterior, Structural I sheathing.

1. Span Rating: Not less than 16/0.
2. Nominal Thickness: Not less than 1/2 inch.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For parapet sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
2. For wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

B. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

## PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

## 3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Roof Sheathing:

a. Screw to cold-formed metal framing.
b. Space panels 1/8 inch apart at edges and ends.

## 3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions and the following:

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

**END OF SECTION 061600**

## SECTION 062023 - INTERIOR FINISH CARPENTRY

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Interior trim.

### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Interior trim.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

E. Samples for Verification:

1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.
2. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. for lumber and 8 by 10 inches for panels.

### 1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
2. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**PART 2 - PRODUCTS**

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber, mark grade stamp on end or back of each piece.

B. Hardboard: ANSI A135.4.

2.2 INTERIOR TRIM

A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: White Birch NHLA Clear.
2. Maximum Moisture Content: 10 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Not allowed.
5. Face Surface: Surfaced (smooth).
6. Matching: Selected for compatible grain and color.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

2.4 FABRICATION

A. Back out or kerf backs of the following members, except those with ends exposed in finished work:

1. Interior standing and running trim, except shoe and crown molds.

B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

### 3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

### 3.4 INSTALLATION OF INTERIOR TRIM

A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.

1. Do not use pieces less than 24 inches long, except where necessary.
2. Stagger joints in adjacent and related standing and running trim.

3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
4. Use scarf joints for end-to-end joints.
5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

## 3.5 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements.

1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

## 3.6 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces.

B. Restore damaged or soiled areas and touch up factory-applied finishes if any.

## 3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION 062023**

## SECTION 064113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Wood-veneer-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing architectural cabinets that are not concealed within other construction.
3. Shop finishing of architectural cabinets.

### 1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For architectural cabinets.

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in architectural cabinets.
5. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples: For each exposed product and for each color and finish specified, in manufacturer's standard size.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.

2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished cabinets.

3. Corner Pieces:

   a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
   b. Miter joints for standing trim.

4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

F. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. <Double click to insert sustainable design text for regional materials.>
3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
4. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For the following:

1. Composite wood and agrifiber products.
2. Glass.
3. Adhesives.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

**PART 2 - PRODUCTS**

2.1 CABINETS, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of architectural cabinets indicated for construction, finishes, installation, and other requirements.

2.2 WOOD CABINETS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium.

B. Regional Materials: Manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

D. Type of Construction: Frameless.

E. Door and Drawer-Front Style: Flush overlay.

1. Reveal Dimension: 1/2 inch.

F. Wood for Exposed Surfaces:

1. Species: White Birch, Rotary Cut.
2. Blueprint Matching: Comply with veneer and other matching requirements indicated for blueprint-matched paneling.
3. Cut: Rotary Cut.
4. Grain Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.
5. Matching of Veneer Leaves: Book match.
6. Veneer Matching within Panel Face: Running match.

7. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.

G. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.

2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, same species indicated for exposed surfaces.
3. Drawer Bottoms: Hardwood plywood.

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

## 2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
2. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Softwood Plywood: DOC PS 1.
2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
3. Recycled Content of MDF and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
4. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

## 2.4 CABINET HARDWARE AND ACCESSORIES

A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

B. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

C. Catches: Magnetic catches, BHMA A156.9, B03141.

D. Shelf Rests: BHMA A156.9, B04013; two-pin plastic with shelf hold-down clip.

E. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted.

a. Type: Full extension.
b. Material: Epoxy-coated steel with polymer rollers.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel, ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.

F. Door Locks: BHMA A156.11, E07121. Provide 1 per Door.

G. Drawer Locks: BHMA A156.11, E07041. Provide 1 per Drawer.

H. Door and Drawer Silencers: BHMA A156.16, L03011.

I. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: Black.

2. Provide 1 per 4’-0” of counter space.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

## 2.6 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated. Ease edges and corners to 1/16-inch radius unless otherwise indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.7 SHOP FINISHING

A. General: Finish architectural cabinets at manufacturer's shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural cabinets, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish: System - 4, water-based latex acrylic.
3. Staining: Match approved sample for color.
4. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D523.

**PART 3 - EXECUTION**

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with cabinet surface.

1. For shop-finished items, use filler matching finish of items being installed.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inchesusing concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Maintain veneer sequence matching of cabinets with transparent finish.
4. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

## 3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces. Touch up finishes to restore damaged or soiled areas.

**END OF SECTION 064113**

## SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

### 1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.

a. Provide one sample applied to core material with specified edge material applied to one edge.

2. Corner Pieces:

   a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
   b. Miter joints for standing trim.

3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For each type of product.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

**PART 2 - PRODUCTS**

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Premium.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

1. Reveal Dimension: 1/2 inch.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Wilsonart LLC. (Basis of Design)
2) Formica Corporation.
3) Pionite; a Panolam Industries International, Inc. brand.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade VGS.
3. Edges: PVC edge banding with radiused edges, 0.12 inch thick, matching laminate in color, pattern, and finish.
4. Pattern Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade CLS Thermoset decorative panels.

a. Edges of Plastic-Laminate Shelves: PVC edge banding with radiused edges, 0.12 inch thick, matching laminate in color, pattern, and finish.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.
2. As selected by Architect from laminate manufacturer's full range in the following categories:

    a. Solid colors, matte or gloss finish.
    b. Solid colors with core same color as surface, matte or gloss finish.
    c. Patterns, matte or gloss finish.

## 2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

    1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

    1. Particleboard: ANSI A208.1, Grade M-2.

    2. Softwood Plywood: DOC PS 1.

    3. Recycled Content of MDF and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
    4. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

## 2.3 CABINET HARDWARE AND ACCESSORIES

A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

B. Back-Mounted Pulls: BHMA A156.9, B02011.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

D. Catches: Magnetic catches, BHMA A156.9, B03141.

E. Shelf Rests: BHMA A156.9, B04013; plastic two-pin plastic with shelf hold-down clip.

F. Drawer Slides: BHMA A156.9.

    1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.

        a. Type: Full extension.
        b. Material: Epoxy-coated steel with polymer rollers.

    2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
    3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1HD-100.

4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.

G. Door Locks: BHMA A156.11, E07121. Provide one per door.

H. Drawer Locks: BHMA A156.11, E07041. Provide one per drawer.

I. Door and Drawer Silencers: BHMA A156.16, L03011.

J. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: Black.

2. Provide 1 per 4’-0” of counter.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

## 2.5 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

### 3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

### 3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

### 3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

**END OF SECTION 064116**

**SECTION 064216 - FLUSH WOOD PANELING**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Flush wood paneling (wood-veneer wall surfacing).
2. Installation materials.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For flush wood paneling.

1. Include plans, elevations, sections, and attachment details.
2. Show details full size.
3. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
4. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
5. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished paneling.
3. Veneer-Faced Panel Products for Transparent Finish: 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.5 FIELD CONDITIONS

A. Environmental Limitations with Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

C. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

**PART 2 - PRODUCTS**

2.1 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.

2.2 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

A. Grade: Premium.

B. Wood Species and Cut: White Birch, Rotary Cut.

C. Veneer Matching Method:

1. Adjacent Veneer Leaves: Book match.
2. Within Panel Face: Balance match.

D. Panel Core Construction: Hardwood veneer-core plywood.

1. Thickness: 3/4 inch.

E. Exposed Panel Edges: Applied solid-wood banding 11/16 inch thick by depth of panels.

F. Panel Reveals: Stained Wood.

G. Assemble panels by gluing and concealed fastening.

## 2.3 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Wood Moisture Content: 5 to 10 percent.

C. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

1. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

## 2.4 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

## 2.5 FABRICATION

A. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.

B. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## 2.6 SHOP FINISHING

A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished paneling specified to be field finished. See Section 099300 "Staining and Transparent Finishing" for material and application requirements.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.

1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.

D. Transparent Finish: See Section 099300 "Staining and Transparent Finishing" for final finishing of installed paneling

**PART 3 - EXECUTION**

3.1 PREPARATION

A. Before installation, condition paneling to humidity conditions in installation areas.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch.

C. Anchor paneling to supporting substrate with blind nailing.

1. Do not use face fastening unless covered by trim.

D. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

E. See Section 099300 "Staining and Transparent Finishing" for final finishing of installed paneling.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.

B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

**END OF SECTION 064216**

## SECTION 071113 - BITUMINOUS DAMPPROOFING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Cold-applied, emulsified-asphalt dampproofing.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

## PART 2 - PRODUCTS

### 2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Trowel Coats: ASTM D 1227, Type II, Class 1.

B. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

C. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

D. VOC Content: Zero.

### 2.2 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.

1. Test for surface moisture according to ASTM D 4263.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.

C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

### 3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.

1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.

1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
2. Lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat.

B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat.

C. Masonry Backup for Brick Veneer Assemblies: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft..

D. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft..

3.5 CLEANING

A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

**END OF SECTION 071113**

## SECTION 071700 - BENTONITE WATERPROOFING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Bentonite waterproofing.
2. Molded-sheet drainage panels.
3. Insulation.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include product specifications and manufacturer's written installation instructions.

B. Shop Drawings: Show installation details for interface with other work.

C. Samples: For each of the following products, in sizes indicated:

1. Waterproofing: 6 inches square.
2. Drainage Panels: 6 inches square.
3. Insulation: 6 inches square.

### 1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain bentonite waterproofing system from single source from single manufacturer. Obtain accessory products used with bentonite waterproofing from sources acceptable to bentonite waterproofing manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original unopened and undamaged containers.

B. Store materials in a dry, well-ventilated space.

C. Remove and replace bentonite materials that have been prematurely exposed to moisture.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit bentonite waterproofing to be installed according to manufacturers' written instructions and warranty requirements.

1. Do not apply waterproofing materials to surfaces where ice or frost is visible. Do not apply bentonite waterproofing materials in areas with standing water.
2. Placing bentonite clay products in panel or composite form on damp surfaces is allowed if approved in writing by manufacturer.

**PART 2 - PRODUCTS**

2.1 GEOTEXTILE/BENTONITE SHEETS

A. Geotextile/Bentonite Waterproofing: Minimum of 1.0 lb/sq. ft. of bentonite clay granules between two layers of geotextile polypropylene fabric, one woven and one nonwoven, needle punched and heat fused together.

1. Grab Tensile Strength: **95 lbf** according to ASTM D 4632.

2.2 INSTALLATION ACCESSORIES

A. Granular Bentonite: Sodium bentonite clay containing a minimum of 90 percent montmorillonite (hydrated aluminum silicate), with a minimum of 90 percent passing a No. 20 sieve.

B. Bentonite Mastic: Trowelable consistency, bentonite compound, specifically formulated for application at joints and penetrations.

C. Granular Bentonite Tubes: Manufacturer's standard 2-inch-diameter, water-soluble tube containing approximately 1.5 lb/ft. of bentonite; hermetically sealed; designed specifically for placing on wall footings at line of joint with exterior base of wall.

D. Termination Bar: Extruded-aluminum or formed-stainless-steel bars with upper flange to receive sealant.

E. Plastic Protection Sheet: Polyethylene sheeting complying with ASTM D 4397; thickness recommended by waterproofing manufacturer to suit application but at least 6 mils thick.

F. Cement Grout Patching Material: Manufacturer's recommended grout mix compatible with substrate being patched.

G. Masonry Fasteners: Case-hardened nails or hardened-steel, powder-actuated fasteners. Depending on manufacturer's written requirements, provide 1/2- or 1-inch-diameter washers under fastener heads.

H. Sealants: As recommended in writing by waterproofing manufacturer. Comply with requirements specified in Division 07 Section "Joint Sealants."

I. Tapes: Waterproofing manufacturer's recommended tape for joints between sheets, membranes, or panels.

J. Adhesive: Water-based adhesive used to secure waterproofing to both vertical and horizontal surfaces.

K. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners, and as follows:

1. Thickness: 1/4 inch, nominal.

L. Geotextile Protection Course: As recommended by waterproofing manufacturer.

M. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, shiplap edged.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.
d. Pactiv Corporation.
e. T. Clear Corporation.

2. Type VI, 40-psi minimum compressive strength.
3. Type VII, 60-psi minimum compressive strength.
4. Type V, 100-psi minimum compressive strength.

N. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VI, 40-psi minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate preparations affecting performance of bentonite waterproofing.

B. Verify that substrate is complete and that work that will penetrate waterproofing is complete and rigidly installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Coordinate work in the vicinity of waterproofing to ensure proper conditions for installing the waterproofing system and to prevent damage to waterproofing after installation.

B. Formed Concrete Surfaces: Remove fins and projections. Fill voids, rock pockets, form-tie holes, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.

C. Horizontal Concrete Surfaces: Remove debris, standing water, oily substances, mud, and similar substances that could impair the bonding ability of concrete or the effectiveness of waterproofing. Fill voids, cracks greater than 1/8 inch, honeycomb areas, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.

D. Excavation Support and Protection System: If water is seeping, use plastic protection sheets or other suitable means to prevent wetting the bentonite waterproofing. Fill minor gaps and spaces 1/8 inch wide or wider with wood, metal, concrete, or other appropriate filling material. Cover or fill large voids and crevices with cement mortar according to manufacturer's written instructions.

## 3.3 INSTALLATION, GENERAL

A. Install waterproofing and accessories according to manufacturer's written instructions.

1. Apply granular bentonite around penetrations in horizontal surfaces and changes in plane according to manufacturer's details in preparation for granular bentonite tubes and mastic.

B. Apply granular bentonite tubes continuously on footing against base of wall to be waterproofed according to manufacturer's written instructions.

C. Protect waterproofing from damage and wetting before and during subsequent construction operations. Repair punctures, tears, and cuts according to manufacturer's written instructions.

D. Install protection course before backfilling or placing overburden when recommended by waterproofing manufacturer.

## 3.4 GEOTEXTILE/BENTONITE SHEET INSTALLATION

A. General: Install a continuous layer of waterproofing sheets directly against concrete to be waterproofed. Lap ends and edges a minimum of 4 inches on horizontal and vertical substrates. Stagger end joints between sheets a minimum of 24 inches. Fasten seams by stapling to adjacent sheet or nailing to substrate.

B. Below Structural Slabs-on-Grade: Place waterproofing sheets on compacted substrate with ends and edges lapped and stapled.

1. Install a layer of waterproofing sheets under footings, grade beams, and pile caps; or continue waterproofing through key joints between footings and foundation walls, and extend a minimum of 8 inches up or beyond perimeter slab forms.

C. Concrete Walls: Starting at bottom of wall, apply waterproofing sheets horizontally with primary backing side against wall. Secure with masonry fasteners spaced according to manufacturer's written instructions. Extend to bottom of footing, grade beam, or wall, and secure.

1. Termination at Grade: Extend waterproofing sheets to within 2 inches of finish grade unless otherwise indicated. Secure top edge with termination bar. Apply sealant to top edge of termination bar.
2. Termination at Grade: Fasten top edge of waterproofing sheets to wall and protect top edge with sheet metal counterflashing. Cover waterproofing with a lapped course of plastic protection sheets if backfilling does not proceed immediately.

D. Excavation Support and Protection (Permanent Shoring): Encase tieback rods, nuts, and plates, using bentonite mastic and waterproofing sheets, according to waterproofing manufacturer's written instructions for each configuration.

1. Install a layer of waterproofing sheets, with ends and edges lapped and nailed to shoring. Cover waterproofing with plastic protection sheets if needed for protection from precipitation; remove plastic sheets before placing concrete.

2. Inspect and repair waterproofing after reinforcing steel has been placed. Coordinate and control concrete placement to avoid damage to waterproofing.

## 3.5 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate. Use adhesives **or** mechanical fasteners that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

## 3.6 INSULATION INSTALLATION

A. Install one or more layers of board insulation to achieve required thickness and insulation drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.

B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

C. On horizontal surfaces, loosely lay insulation units. Stagger end joints and tightly abut insulation units.

## 3.7 FIELD QUALITY CONTROL

A. Inspection: Arrange for manufacturer's representative to inspect completed waterproofing installation before covering with other construction and provide written report that installation complies with manufacturer's written instructions.

1. Remove and replace applications of bentonite waterproofing where inspection indicates that it does not comply with specified requirements.

B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch but not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of membrane flashings.
2. Flood each area for 24 hours.
3. After flood testing, repair leaks, repeat flood test, and make further repairs until waterproofing installation is watertight.

C. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

**END OF SECTION 071700**

## SECTION 072100 - THERMAL INSULATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Glass-fiber blanket insulation.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

### 1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

### 1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.

B. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

C. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inchesand wider in width.

D. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

### 2.2 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. DiversiFoam Products.
2. Dow Chemical Company (The).
3. Owens Corning, Formular High-R CW Plus (Basis of Design)
4. Type IV, 25 psi, 1.55 pcf density.
5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

### 2.3 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Johns Manville; a Berkshire Hathaway company.
3. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

### 2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Angle: Formed from 0.030-inch-thick, perforated, galvanized carbon-steel sheet with each leg 2 inches square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

### 3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

## 3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

## 3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

## 3.6 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 072100**

## SECTION 072500 - WEATHER BARRIERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Building wrap.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

## PART 2 - PRODUCTS

### 2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Chemical Company (The).
b. DuPont Building Innovations: E. I. du Pont de Nemours and Company.
c. Ludlow Coated Products.
d. Reemay, Inc.

2. Water-Vapor Permeance: Not less than 20 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.
4. Allowable UV Exposure Time: Not less than three months.
5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

## PART 3 - EXECUTION

### 3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

B. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

C. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

**END OF SECTION 072500**

## SECTION 074113 - STANDING-SEAM METAL ROOF PANELS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.

### 1.3 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

### 1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified NC Professional Engineer, using performance requirements and design criteria indicated.

C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at the following test-pressure difference:

1. Test-Pressure Difference: Negative 1.57 lbf/sq. ft..

D. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

G. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance: MH.

H. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

a. Wind speed as indicated on Drawings.

2. Snow Loads: Load indicated on Drawings.
3. Deflection Limits: Metal roof panel assemblies shall withstand wind and snow loads with vertical deflections no greater than 1/240 of the span.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

J. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

K. Energy Performance: Provide roof panels that are listed on the U.S. Department of Energy's ENERGY STAR Roof Products Qualified Product List for steep-slope roof products.

L. Energy Performance: Provide roof panels with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

## 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of roof panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

a. Flashing and trim.
b. Gutters.
c. Downspouts.

C. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, closures, and other metal roof panel accessories.
2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch-long Samples for each type of accessory.

E. Delegated-Design Submittal: For metal roof panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof panels and attachments.
2. Purlins and rafters.
3. Roof-mounted items including bar joists, pipe and penetrations, and snow guards.

B. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements.

C. Qualification Data: For qualified Installer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

E. Field quality-control reports.

F. Warranties: Samples of special warranties.

## 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal roof panels to include in maintenance manuals.

## 1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.

C. Surface-Burning Characteristics: Provide metal roof panels having insulation core material with the following surface-burning characteristics as determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

D. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
4. Examine deck substrate conditions for compliance with requirements, including flatness and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
8. Review temporary protection requirements for metal roof panel assembly during and after installation.
9. Review roof observation and repair procedures after metal roof panel installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

E. Protect foam-plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## 1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof 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 roof panels by field measurements before fabrication.

1.11 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Project Acceptance.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Project Acceptance.

C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance:

1. Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for steep-slope roof products.
2. Provide roof panels according to one of the following when tested according to CRRC-1:

a. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
b. Three-year, aged Solar Reflectance Index of not less than 64 when calculated in accordance with ASTM E1980.

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

G. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A- 105.
2. Hail Resistance: MH.

H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 FIELD-INSTALLED THERMAL INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60-lb/cu. ft. minimum density unless otherwise indicated; with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively. Insulation shall comply with Underwriters Laboratories (UL) Inc. Roof Deck Construction #457, tested in accordance with ANSI/UL Standard 1256. This application requires that the insulation be capable of spanning across rib openings in the deck and provide reasonable resistance to foot traffic and other normal roof loads.

## 2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
3. Products: Subject to compliance with requirements,provide one of the following:

    a. Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.; CCW WIP 300HT.
    b. Grace Construction Products; a unit of Grace, W. R. & Co.; Ultra.
    c. Henry Company; Blueskin PE200 HT.
    d. Metal-Fab Manufacturing, LLC; MetShield.
    e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

## 2.4 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.

B. Cold-Rolled Furring Channels: Minimum 1/2-inch-wide flange.

1. Nominal Thickness: As required to meet performance requirements.
2. Depth: As required.
3. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with nominal thickness of 0.040 inch.
4. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

C. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.

1. Nominal Thickness: 0.025 inch.

D. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

## 2.5 MISCELLANEOUS MATERIALS

A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.6 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching

panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis-of-Design Product: Subject to compliance with requirements and ability to match existing building, provide Construction Metals Products or comparable product by one of the following:

   a. AEP-Span.
   b. Berridge Manufacturing Company.
   c. Merchant & Evans.
   d. Construction Metal Products, Inc.
   e. Metal Roofing System, Inc.

2. Material: Zinc-coated (galvanized) steel sheet, 24 guage nominal thickness.

   a. Exterior Finish: 2-coat fluoropolymer.
   b. Color: As selected from Manufacturer's full range of colors including metallic and silver grays to match adjacent roofs.

3. Batten: Same material, finish, and color as roof panels.
4. Clips: Floating to accommodate thermal movement.

   a. Material: 0.064-inch-nominal thickness, zinc-coated (galvanized) steel sheet.

5. Joint Type: Double folded.
6. Panel Coverage: 16 inches.
7. Panel Height: 2.0 inches.

## 2.7 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

## 2.8 ACCESSORIES

A. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

B. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum 0.018 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.

D. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Finish downspouts to match gutters.

## 2.9 FABRICATION

A. Fabricate and finish metal roof 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. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.

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. End Seams for Other Than Aluminum: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

## 2.10 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. 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.

B. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

C. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

D. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

E. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Substrate Board: Install substrate boards over roof deck on entire roof surface. Attach with substrate-board fasteners.

1. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

C. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

### 3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply over entire roof area, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

B. Apply slip sheet over underlayment before installing metal roof panels.

C. Install flashings to cover underlayment to comply with requirements specified in Division 07 Section "Sheet Metal Flashing and Trim."

## 3.4 THERMAL INSULATION INSTALLATION

A. Board Insulation: Extend insulation in thickness indicated to cover entire roof. Comply with installation requirements in Division 07 Section "Thermal Insulation."

1. Erect insulation and hold in place with Z-shaped furring members spaced 24 inches o.c. Securely attach narrow flanges of furring members to roof deck with screws spaced 24 inches o.c.

## 3.5 METAL ROOF PANEL INSTALLATION, GENERAL

A. Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

B. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Predrill panels for fasteners.

1. Point of Fixity: Fasten each panel along a single line of fixing located at eave
2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.

C. Install metal roof panels as follows:

1. Commence metal roof panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
2. Field cutting of metal panels by torch is not permitted.
3. Install panels perpendicular to purlins.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Provide metal closures at rake edges, rake walls and each side of ridge and hip caps.
6. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
7. Install ridge and hip caps as metal roof panel work proceeds.
8. End Splices: Locate panel end splices over, but not attached to, structural supports. Stagger panel end splices to avoid a four-panel splice condition.
9. Install metal flashing to allow moisture to run over and off metal roof panels.

D. Fasteners:

1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized-steel fasteners for surfaces exposed to the interior.

E. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

F. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

## 3.6 METAL SOFFIT PANEL INSTALLATION

A. In addition to complying with requirements in "Metal Roof Panel Installation, General" Article, install metal soffit panels to comply with requirements in this article.

B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.

1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

C. Metal Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fascia meet soffits, along lower panel edges, and at perimeter of all openings.

## 3.7 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

## 3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

## 3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof 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.

## 3.10 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 074113**

## SECTION 074293 - METAL SOFFIT PANELS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes metal soffit panels.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Project Acceptance.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 METAL SOFFIT PANELS

A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Metal Soffit Panels: Match profile and material of metal roof panels.

1. Finish: Match finish and color of metal roof panels.
2. Sealant: Factory applied within interlocking joint.

C. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.

1. Material: Same material, finish, and color as metal roof panels.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Nominal Thickness: 0.022 inch.
b. Exterior Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

3. Panel Coverage: 12 inches.
4. Panel Height: 1.0 inch.

## 2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

## 2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.

    a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: Wire tie or clip furring channels to supports.

## 3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.

3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

## 3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 074293**

## SECTION 074413 - METAL COMPOSITE MATERIAL WALL PANELS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes metal composite material wall panels.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
8. Review procedures for repair of panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal composite material panel indicated with factory-applied color finishes.

1. Include similar trim samples and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Composite Material Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

## 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal composite material panel assembly 48” x 48”, including corner, soffits, supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test of mockup of metal composite material panel assembly, testing for water penetration according to AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Project Acceptance.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.

B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal composite material panels during installation.

## 1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

## 1.10 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including rupturing, cracking, or puncturing.
    b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Project Acceptance.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

### 2.2 METAL COMPOSITE MATERIAL WALL PANELS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Alcoa Architectural Products (USA).
    b. Alcotex Inc.
    c. ALUCOBOND; 3A Composites USA, Inc. (BASIS FOR DESIGN)
    d. CENTRIA Architectural Systems.

B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch-thick, anodized aluminum sheet facings.

1. Panel Thickness: 0.157 inch.
2. Core: Standard.
3. Exterior Finish:
    a. Clear anodized unless noted otherwise on Drawings.

C. Attachment Assembly Components: Formed from extruded aluminum.

D. Attachment Assembly: Subgirt and spline.

## 2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

## 2.4 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Anodized Aluminum Finish: Clear in accordance with AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

D. Coil-Coated Metal Finish (Manufacturer’s Option):

1. PVDF Fluoropolymer: AAMA 2605, two-coat minimum fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. FEVE Fluoropolymer: AAMA 2605, two-coat fluoropolymer finish containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

## 3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal composite material panels.
2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal composite material panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
2. Copper Panels: Use copper, stainless-steel or hardware-bronze fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.

1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners.

1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.

G. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal tracks and vertical drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach metal composite material wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.

1. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
2. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
3. Do not apply sealants to joints unless otherwise indicated.

H. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

I. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

## 3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

## 3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Metal composite material wall panels will be considered defective if they do not pass test and inspections.

D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

## 3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 074243**

## SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:
   1. Adhered thermoplastic polyolefin (TPO) roofing system.
   2. Substrate board.
   3. Roof insulation.
   4. Cover board.
   5. Walkways.

### 1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
   7. Review governing regulations and requirements for insurance and certificates if applicable.
   8. Review temporary protection requirements for roofing system during and after installation.
   9. Review roof observation and repair procedures after roofing installation.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Roof membrane and flashings, of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Field Test Reports:

1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

## 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

## 1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

## 1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

## 1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

   1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, and other components of roofing system.

   2. Warranty Period: 20 years from date of Project Acceptance.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, and walkway products, for the following warranty period:

   1. Warranty Period: Five years from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-105.
2. Hail-Resistance Rating: MH.

D. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

### 2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlisle SynTec Incorporated (Basis of Design).
    b. Elevate, Holcim Building Envelop Division.
    c. Versico Roofing Systems.

2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
3. Thickness: 60 mils, nominal.
4. Exposed Face Color: Gray.
5. Exposed Face Color Parapet Walls: Gray.
6. Provide peel-off protective film on face of TPO to protect membrane during installation. Remove upon completion of the project or as directed by the Archtiect.

## 2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 60 mils thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Roof Vents: As recommended by roof membrane manufacturer.

1. Size: Not less than 4-inch diameter.

E. Bonding Adhesive: Manufacturer's standard.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

## 2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/2 inch thick.
2. Surface Finish: Factory primed.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

## 2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer, approved for use in FM Approvals' RoofNav-listed roof assemblies.

B. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. minimum density, 25-psi minimum compressive strength, square edged.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.

2. Thermal Resistance: R-value of 5.0 per inch.
3. Size: 48 by 96 inches.
4. Thickness:

    a. 2 inches minimum plus taper.

C. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch. 0” start at crickets.
3. Slope:

    a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

## 2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Georgia-Pacific Gypsum LLC.
    b. National Gypsum Company.
    c. USG Corporation.

2. Thickness: 1/2 inch.
3. Surface Finish: Factory primed.

## 2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

1. Size: Approximately30 by 30 inches.
2. Color: Match roof membrane.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
1. Submit test result within 24 hours after performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

## 3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie into existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

## 3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install insulation with joints staggered not less than 24 inches in adjacent rows.

    a. Locate end joints over crests of decking.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
        1) Trim insulation so that water flow is unrestricted.
    e. Fill gaps exceeding 1/4 inch with insulation.
    f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    g. Loosely lay base layer of insulation units over substrate.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
        1) At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches. Trim insulation so that water flow is unrestricted.
    e. Fill gaps exceeding 1/4 inch with insulation.
    f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    g. Loosely lay each layer of insulation units over substrate.

D. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

    a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    c. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
        1) Trim insulation so that water flow is unrestricted.
    d. Fill gaps exceeding 1/4 inch with insulation.
    e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    f. Adhere base layer of insulation to concrete roof deck according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
1) Trim insulation so that water flow is unrestricted.
e. Fill gaps exceeding 1/4 inch with insulation.
f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

## 3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.

4. Loosely lay cover board over substrate.

a. Mechanically attach substrate board, insulation, and cover board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
3) No less than one fastener per two square feet in pattern approved by Architect with 50% increase within 8 feet of perimeter edge of any roof.

b. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place

## 3.7 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

## 3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

## 3.9 WALKWAY INSTALLATION

A. Flexible Walkways:

1. Install flexible walkways at the following locations:

    a. Locations indicated on Drawings.

2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

## 3.10 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

C. Perform the following tests:

1. Flood Testing: Flood test each roof area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

    a. Perform tests before overlying construction is placed.
    b. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inchesof clearance from top of base flashing.
    c. Flood each area for 24 hours.
    d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is Contractor's responsibility.

    e. Testing agency to prepare survey report indicating locations of initial leaks, if any, and final survey report.

2. Infrared Thermography: Testing agency surveys entire roof area using infrared color thermography according to ASTM C1153.

    a. Perform tests before overlying construction is placed.
    b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection tests.
    c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is Contractor's responsibility.

    d. Testing agency to prepare survey report of initial scan indicating locations of entrapped moisture, if any.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

F. Roof shall be free of visible defects including, but not limited to, staining, spills, wrinkles, all ponding, etc.

## 3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

## 3.12 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: .
2. Address: .
3. Building Name/Type: .
4. Address: .
5. Area of Work: .
6. Acceptance Date: _____.
7. Warranty Period: .
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding 72 MPH;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and

g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

**END OF SECTION 075423**

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Low-slope roof sheet metal fabrications.

### 1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.

7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

E. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

## 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

## 1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, including fascia, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Project Acceptance.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range including metallics.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

## 2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Source Limitations: Obtain underlayment from single source from single manufacturer.
2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

## 2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Not permitted.
    b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

G. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

## 2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:

a. Aluminum-Zinc Alloy-Coated Steel: 0.050 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, fasten and seal watertight. Shop fabricate continuous interior and exterior corners.

1. Coping Profile: As indicated and in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
3. Fabricate from the following materials:

a. Aluminum-Zinc Alloy-Coated Steel: 0.050 inch thick.

B. Flashing Receivers: Fabricate from the following materials:

a. Aluminum-Zinc Alloy-Coated Steel: 0.050 inch thick.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

## 3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

## 3.4 INSTALLATION OF ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Parapet Scuppers:

1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
2. Anchor scupper closure trim flange to exterior wall and solder to scupper.
3. Loosely lock front edge of scupper with conductor head.
4. Solder exterior wall scupper flanges into back of conductor head.

## 3.5 INSTALLATION OF SLOPED ROOF SHEET METAL FABRICATIONS

A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Copings:

1. Install copings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.

a. Interlock interior and exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

## 3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

## 3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

## 3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

**END OF SECTION 076200**

## SECTION 077200 - ROOF ACCESSORIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Manufactured units for the following applications:

1. Roof hatches.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof accessories in contact with other materials that might cause staining, denting, or other surface damage. Store roof accessories in accordance with manufacturer's instructions.

B. Store materials off ground in dry location and in accordance with manufacturer's instructions in well-ventilated area.

C. Store and protect roof accessories from nicks, scratches, and blemishes.

### 1.5 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-accessory substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

### 1.6 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

### 2.2 ROOF HATCHES

A. Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AES Industries, Inc.
2. Architectural Specialties, Inc.
3. Babcock-Davis.
4. Best Access Doors.
5. JL Industries; Activar Construction Products Group, Inc.
6. KCC Manufacturing.
7. Metallic Products Corporation.
8. Nystrom, Inc.
9. Pate Company (The).

C. Type and Size:

1. Single-leaf lid, 30 by 48 inches.

D. Loads: Minimum 40 lbf/sq. ft. external live load and 20 lbf/sq. ft. internal uplift load.

E. Hatch Material, Steel: Aluminum-zinc alloy-coated steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Mill phosphatized.
3. Color: As indicated by manufacturer's designations.

F. Construction:

1. Insulation: 1-inch-thick, cellulosic-fiber board.

    a. R-Value: 2.78 in accordance with ASTM C1363.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
6. Sloping Roofs: Where slope or roof deck exceeds 1/4 inch per 12 inches, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

G. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches.

H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Steel tube.
4. Post: 1-5/8-inch- diameter pipe.
5. Finish: Safety Yellow.

2.3 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500, "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. 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.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install roof accessories in accordance with manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended in writing by manufacturer's written installation instructions.

## 3.3 INSTALLATION OF ROOF ACCESSORIES

A. Equipment Support: Install equipment supports so top surfaces are level with each other.

B. Roof-Hatch:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach safety railing system to roof-hatch curb.
3. Attach ladder-assist post in accordance with manufacturer's written instructions.

C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

## 3.4 CLEANING AND PROTECTION

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Section 099113 "Exterior Painting."

C. On completion of installation, clean exposed surfaces in according with manufacturer's written instructions. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as roof accessories are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof accessories in a clean condition during construction.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Architect.

**END OF SECTION 077200**

**SECTION 077253 - SNOW GUARDS**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Rail-type, seam-mounted snow guards.

### 1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Structural Performance:

1. Snow Loads: As indicated on Drawings.

### 2.2 RAIL-TYPE SNOW GUARDS

A. Seam-Mounted, Rail-Type Snow Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
b. S-5! Attachment Solutions; Metal Roof Innovations, Ltd.

c. Snow Management Systems.
d. TRA SNOW & SUN, INC.

2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with the number and type of rails to match the existing roof.
3. Material and Finish: Stainless steel; Match existing..

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

A. Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer.

B. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing, or fastening methods that void metal roofing finish warranty.
2. Seam-Mounted, Rail-Type Snow Guards: Stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.

**END OF SECTION 077253**

## SECTION 078413 - PENETRATION FIRESTOPPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

C. Sustainable Design Submittals:

1. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

### 1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
b. Classification markings on penetration firestopping correspond to designations listed by the following:

1) UL in its "Fire Resistance Directory."

B. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

**PART 2 - PRODUCTS**

2.1 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Fire-resistance-rated walls include fire-barrier walls and fire partitions.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1. Verify sealant has a VOC content of 250 g/L or less.

D. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:

a. Slag-wool-fiber or rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

## 2.2 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.3 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

## 3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

## 3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

## 3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Project Acceptance. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

**END OF SECTION 078413**

**SECTION 078443 - JOINT FIRESTOPPING**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

### 1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

### 1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.

D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1. Verify sealant has a VOC content of 250 g/L or less.

E. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content:

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

## 3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

## 3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

## 3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Project Acceptance. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

**END OF SECTION 078443**

**SECTION 079200 - JOINT SEALANTS**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silyl-terminated polyether joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

### 1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Project Acceptance.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Project Acceptance.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

**PART 2 - PRODUCTS**

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

B. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Uses T and NT.

C. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 100/50, Uses T and NT.

## 2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

## 2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

## 2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

## 2.6 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

## 3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
4. Provide flush joint profile at all locations according to Figure 8B in ASTM C 1193.

## 3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.
b. Whether sealant dimensions and configurations comply with specified requirements.
c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

## 3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

## 3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Project Acceptance. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

## 3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, S, P, 50, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints in unit masonry.
b. Joints between metal panels.
c. Joints between different materials listed above.
d. Perimeter joints between materials listed above and frames of doors windows and louvers.
e. Control and expansion joints in ceilings.
f. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Control and expansion joints in tile flooring.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, S, P, 100/50, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Tile control and expansion joints.
c. Vertical joints on exposed surfaces of unit masonry, walls and partitions.
d. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Around perimeter of floors, ceiling, and doors, in Clean Room, Dressing, and DCON.
d. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, S, P, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

**END OF SECTION 079200**

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.

### 1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

### 1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

### 1.4 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

## 2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule on Drawings.
   b. Thickness: 1-3/4 inches.
   c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
   d. Edge Construction: Model 1, Full Flush.
   e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches.
   f. Core: Manufacturer's standard.
   g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rateddoors.

2. Frames:

   a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
   b. Construction: Full profile welded.

3. Exposed Finish: Prime.

## 2.3 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

## 2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

E. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

## 2.5 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

## 2.6 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames in accordance with NFPA 80.

3. Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

**END OF SECTION 081113**

## SECTION 081213 - HOLLOW METAL FRAMES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes hollow-metal frames.

### 1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

### 1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
2. Locations of reinforcement and preparations for hardware.
3. Details of each different wall opening condition.
4. Details of anchorages, joints, field splices, and connections.
5. Details of moldings, removable stops, and glazing.
6. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

### 1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each unit to permit air circulation.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR FRAMES

A. Construct interior frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Hollow-Metal Frames: NAAMM-HMMA 860..

1. Physical Performance: Level A according to SDI A250.4.
2. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
3. Construction: Full profile welded.
4. Exposed Finish: Prime.

## 2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.

## 2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Glazing: Comply with requirements in Section 088000 "Glazing."

## 2.6 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

4. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce frames to receive nontemplated, mortised, and surface-mounted hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

D. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames.
3. Provide loose stops and moldings on inside of hollow-metal work.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

## 2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## 2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted hardware.

## 3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
3. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

**END OF SECTION 081213**

**SECTION 081416 - FLUSH WOOD DOORS**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish**.** For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
    a. Provide Samples for each species of veneer and solid lumber required.
    b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Graham Wood Doors; ASSA ABLOY Group company.
4. Marshfield DoorSystems, Inc.
5. Mohawk Flush Doors, Inc.
6. Oshkosh Door Company.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
4. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf.
b. Screw Withdrawal, Edge: 400 lbf.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade AA faces.
2. Species: Select white birch.
3. Cut: Rotary cut.
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same openingor separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
8. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
9. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
10. Core: Glued wood stave.
11. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
12. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

## 2.4 LIGHT FRAMES AND LOUVERS

A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

## 2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

## 2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted ontop and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 9, UV curable, acrylated epoxy, polyester, or urethane System 11, catalyzed polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Filled finish.
5. Sheen: Semigloss.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.

a. Comply with NFPA 80 for fire-rated doors.
b. 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

2. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### 3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

**END OF SECTION 081416**

## SECTION 083113 - ACCESS DOORS AND FRAMES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.

B. Product Data: For each type of product.

1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

## PART 2 - PRODUCTS

### 2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

B. Flush Access Doors with Concealed Flanges:

1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
2. Locations: Wall and ceiling as required to access items above ceiling.
3. Door Size: 24 x 24.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.

    a. Finish: Factory prime.

5. Frame Material: Same material and thickness as door.
6. Hinges: Manufacturer's standard.
7. Hardware: Latch.

C. Hardware:

1. Latch: Cam latch operated by screwdriver.
2. MATERIALS

D. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

F. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

G. Frame Anchors: Same type as door face.

H. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.2 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

## 2.3 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. 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.

D. Steel and Metallic-Coated-Steel Finishes:

1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

### 3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

**END OF SECTION 083113**

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Exterior framing.
2. Exterior Aluminum FRP Doors.
3. Exterior Aluminum Entrance Doors.

### 1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

### 1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Glazing-to-glazing contact.
e. Noise or vibration created by wind and by thermal and structural movements.
f. Loosening or weakening of fasteners, attachments, and other components.
g. Sealant failure.
h. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings..

2. Seismic Loads: As indicated on Drawings.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressre difference of 20 percent of positive wind-load design pressure, but not less then 6.24 lbf/sq. ft..

G. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

1. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 0 deg F.

3. Interior Ambient-Air Temperature: 75 deg F.

I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 > when tested according to AAMA 1503.

J. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x deg Fwhen tested according to AAMA 1503.

K. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:

1. Sound Transmission Class (STC): Minimum 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
2. Outdoor-Indoor Transmission Class (OITC): Minimum 26 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.5 PERFORMANCE REQUIREMENTS- FRP Doors

A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.
B. Indoor air quality testing per ASTM D 6670-01: GREENGUARD Environmental Institute Certified including GREENGUARD for Children and Schools Certification.
C. Impact Strength, AMP Doors and Panels, Nominal Value, ASTM D 256: 2.6 foot-pounds per inch of notch.
D. Tensile Strength, AMP Doors and Panels, Nominal Value, ASTM D 638: 7,500 psi.
E. Flexural Strength, AMP Doors and Panels, Nominal Value, ASTM D 790: 16,900 psi.
F. Water Absorption, AMP Doors and Panels, Nominal Value, ASTM D 570: 0.63 percent after 24 hours.
G. Indentation Hardness, AMP Doors and Panels, Nominal Value, ASTM D 2583: 38.
H. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.022 average weight loss percentage.
I. Compressive Strength, Foam Core, Nominal Value, ASTM D 1621: 79.9 psi.
J. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 370 psi.
K. Tensile Adhesion, Foam Core, Nominal Value, ASTM D 1623: 45.3 psi.
L. Thermal and Humid Aging, Nominal Value, 158 Degrees F and 100 Percent Humidity for 14 Days, ASTM D 2126: Minus 5.14 percent volume change.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inchlengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Flashing and drainage.

F. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project. All design and shop drawings to be signed and sealed by a NC Professional Engineer.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and the NC Accessibility Code Volume I-C.

F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

## 1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components.

2. Warranty Period: Ten years from date of Project Acceptance.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following for Aluminum doors and storefront:

1. Commercial Architectural Products, Inc.
2. EFCO Corporation; (Basis for Design, 433T Storefront Framing (U.N.O.), D300 Aluminum Entrance Doors, and 402 Storefront at Mechanical Room doors )
3. Kawneer North America; an Alcoa company.
4. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
5. YKK AP America Inc.
6. Special-Lite (Basis for Design FRP Doors)

### 2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

### 2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: As indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 ALUMINUM ENTRANCE DOOR SYSTEMS

A. General: Major portions of the door sections shall have .125" (3 mm) wall thickness. Glazing stop sections shall have .050" (1.2 mm) wall thickness.

B. Entrance Doors: Door stiles shall be no less than 6” wide (not including glass stops).

C. Door stiles and rails shall have hairline joints at corners. Heavy concealed reinforcement brackets shall be secured with screws and shall be of deep penetration and fillet welded.

D. All doors shall have an adjusting mechanism in the top rail to provide for minor clearance adjustments.

E. Weather stripping shall be wool pile and shall be installed in one stile of pairs of doors and in jamb stiles of center pivoted doors.

F. Door stops shall include a bulb weather-strip that complies with ASTM E 2203 specification.

G. Glazing: All units shall be dry glazed with extruded pressure fitting aluminum glazing stops, and a gasket that complies with ASTM E 2203 specification.

H. Finish: Clear Anodic

## 2.5 FRP ENTRANCE DOOR SYSTEMS

A. Model: SL-17 Flush Doors with SpecLite3 fiberglass reinforced polyester (FRP) face sheets

B. Construction:
   1. Door Thickness: 1-3/4 inches.
   2. Stiles and Rails: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T5 alloy recovered from industrial processes, minimum of 2-5/16-inch depth.
   3. Corners: Mitered.
   4. 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
   5. Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
   6. Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.
   7. Rail caps or other face sheet capture methods are not acceptable.
   8. Extrude top and bottom rail legs for interlocking continuous weather bar.
   9. Meeting Stiles: Pile brush weatherseals. Extrude meeting stile to include integral pocket to accept pile brush weatherseals.
   10. Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded int locking edge of bottom rail.
   11. Glue: Use of glue to bond sheet to core or extrusions is not acceptable.

C. Face Sheet:
   1. Material: SpecLite3 FRP, 0.120-inch thickness, finish color throughout.
   2. Protective coating: Abuse-resistant engineered surface. Provide FRP with SpecLite3 protective coating, or equal.
   3. Texture: Pebble.
   4. Color: As selected from full range of all available colors.
   5. Adhesion: The use of glue to bond face sheet to foam core is prohibited.

D. Core:
   1. Material: Poured-in-place polyurethane foam.
   2. Density: Minimum of 5 pounds per cubic foot.
   3. R-Value: Minimum of 9.

E. Cutouts:
   1. Manufacture doors with cutouts for required vision lites, louvers, and panels.
   2. Factory install vision lites, louvers, and panels.

F. Hardware:
   1. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
   2. Factory install hardware.

## 2.6 ENTRANCE DOOR HARDWARE

A. Weather Stripping: Manufacturer's standard replaceable components.

   1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
   2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

B. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

## 2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-milthickness per coat.

## 2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to the greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

G. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

### 3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:

    a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
    b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

## 3.4 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

**END OF SECTION 084213**

## SECTION 084126 - ALL-GLASS ENTRANCES AND STOREFRONTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Interior all-glass storefronts.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system.

B. Shop Drawings: For all-glass entrances and storefronts.

1. Include plans, elevations, and sections.
2. Include details of fittings and glazing, including isometric drawings of patch fittings.

C. Samples for Initial Selection: For each type of exposed finish indicated.

D. Samples for Verification: For each type of exposed finish indicated, prepared on Samples of size indicated below.

1. Metal Finishes: 6-inch-long sections of patch fittings, accessory fittings, and other items.
2. Glass: 6 inches square, showing exposed-edge finish and tint.

E. Fabrication Sample: Continuous rail fitting at bottom, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Glazing with butt glazing.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Failure of operating components.

2. Warranty Period: Two years from date of Project Acceptance.

a. Concealed Floor Closers: 10 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Avanti Systems, Inc.
2. Blumcraft of Pittsburgh; C.R. Laurence Co, Inc.
3. CRL Aluminum (Basis for Design)
4. Trulite Glass & Aluminum Solutions, LLC.
5. Vistawall Architectural Products.
6. Vitro America.

2.3 METAL COMPONENTS

A. Fitting Configuration:

1. Manual-Swinging, All-Glass Entrance Doors:
2. All-Glass Storefronts: Continuous rail fitting at top and bottom.

B. Patch Fittings: Aluminum.

C. Rail Fittings:

1. Material: Aluminum.
2. Height:

a. Top Rail: 4 inches.
b. Bottom Rail: 4inches.

3. Profile: Tapered.
4. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.

D. Accessory Fittings: Match patch-fitting metal and finish for the following:

1. Overhead doorstop.
2. Center-housing lock.
3. Glass-support-fin brackets.

E. Anchors and Fastenings: Concealed.

F. Materials:

1. Aluminum: ASTM B 221, with strength and durability characteristics of not less than Alloy 6063-T5.

a. Color: Clear Anodized.

2.4 GLASS

A. Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

a. Thickness: 3/4 inch.

2. Exposed Edges: Machine ground and flat polished.
3. Butt Edges: Flat ground.
4. Corner Edges: Lap-joint corners with exposed edges polished.

2.5 BUTT-GLAZING SEALANTS

A. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Uses NT, G, and A.

2.6 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

E. Install butt-joint sealants according to manufacturer's instructions and as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.3 FIELD QUALITY CONTROL

A. After completion of all-glass storefront installation and nominal curing of sealant and glazing compounds, but before installation of interior finishes, test for water leaks according to AAMA 501.2.

B. Work will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

1. For all-glass entrance doors accessible to people with disabilities, adjust closers to provide a three-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

**END OF SECTION 084126**

## SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes conventionally glazed aluminum curtain walls installed as stick assemblies.

### 1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified NC Professional Engineer, using performance requirements and design criteria indicated.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.

D. Structural-Test Performance: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing.

3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.

F. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

G. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

1. Maximum Water Leakage: According to AAMA 501.1 Water leakage does not include water controlled by flashing and gutters that is drained to exterior.

H. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Test Interior Ambient-Air Temperature: 75 deg F.
3. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

I. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft.
4. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC- certified condensation resistance rating of no less than as determined according to NFRC 500.

## 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.

c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified NC Professional Engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Welding certificates.

C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum curtain walls, indicating compliance with performance requirements.

E. Field quality-control reports.

F. Warranties: Sample of special warranties.

## 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

E. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Series 5600 or comparable product by one of the following:

1. EFCO Corporation.
2. Kawneer Company, Inc.; Arconic Corporation.
3. TRACO, a division of Kawneer.
4. YKK AP America Inc.

## 2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard. Provide at all curtain wall verticals as required to maintain depth of frames as indicated on the Contract Drawings.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.3 FRAMING

A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing Sealants: Manufacturer's standard sealants.

## 2.4 GLAZING

A. Glazing: Comply with Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: Comply with Division 08 Section "Glazing."

1. Sealants used inside the weatherproofing system shall have a VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.5 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

## 2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components that, when assembled, have the following characteristics:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Per specified manufacturer.

F. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Seal joints watertight unless otherwise indicated.
3. Install glazing to comply with requirements in Division 08 Section "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Division 08 Section "Glazing."

### 3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.

b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

## 3.4 FIELD QUALITY CONTROL

A. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.

1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

B. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

**END OF SECTION 084413**

## SECTION 085113 - ALUMINUM WINDOWS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes aluminum windows for exterior locations.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.

D. Samples for Initial Selection: For units with factory-applied color finishes.

1. Include similar Samples of hardware and accessories involving color selection.

E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches.
2. Exposed Hardware: Full-size units.

F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: 10 years from date of Project Acceptance.
b. Glazing Units: 10 years from date of Project Acceptance.
c. Aluminum Finish: 10 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO 325G or a comparable product by one of the following:

1. EFCO Corporation.
2. Graham Architectural Products Corp.
3. Kawneer; an Alcoa Company.
4. TRACO.
5. YKK AP America Inc.

B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

## 2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AMMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: AW.
2. Minimum Performance Grade: 80.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 74.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F material surfaces.

G. Sound Transmission Class (STC): Rated for not less than 36 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

## 2.3 ALUMINUM WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Fixed.

B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

C. Insulating-Glass Units: Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

D. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

E. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Subsills: Thermally broken, extruded aluminum subsills in configurations indicated on Drawings.

B. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

C. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

D. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

E. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.

G. Window Assemblies: Provide fixed units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:

1. Angled mullion posts with interior and exterior trim.
2. Angled interior and exterior extension and trim.
3. Exterior head and sill casings and trim.

H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are

not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
2. Air-Infiltration Testing:

    a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
    b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

    a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
5. Test Reports: Prepared according to AAMA 502.

C. Remove and replace noncomplying windows and retest as specified above.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

## 3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

**END OF SECTION 085113**

**SECTION 087100 - DOOR HARDWARE**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Electrified door hardware.

### 1.3 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

B. Keying Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:

a. Flow of traffic and degree of security required.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.

e. Address for delivery of keys.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.

1. Tag Samples with full product description to coordinate Samples with door hardware schedule.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For each type of exposed product, in each finish specified.

1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.

a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

2. Tag Samples with full product description to coordinate Samples with door hardware schedule.

F. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
e. Fastenings and other installation information.
f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
g. Mounting locations for door hardware.

h. List of related door devices specified in other Sections for each door and frame.

G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Architectural Hardware Consultant.

B. Product Certificates: For each type of electrified door hardware.

1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

## 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

## 1.8 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Project Acceptance unless otherwise indicated below:

a. Manual Closers: 10 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/4 inch high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

## 2.3 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3.

## 2.4 HINGES

A. Hinges: BHMA A156.1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allegion plc.
    b. Baldwin Hardware Corporation.
    c. Hager Companies.
    d. McKinney Products Company; an ASSA ABLOY Group company.
    e. PBB, Inc.

## 2.5 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allegion plc.
    b. Hager Companies.
    c. McKinney Products Company; an ASSA ABLOY Group company.
    d. PBB, Inc.
    e. Pemko Manufacturing Co.

f. Select Products Limited.

## 2.6 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
2. Deadbolts: Minimum 1-inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: See Schedule.
2. Levers: Cast.

3. Escutcheons (Roses): Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
b. SARGENT Manufacturing Company; ASSA ABLOY.
c. Yale

## 2.7 AUXILIARY LOCKS

A. Mortise Auxiliary Locks: BHMA A156.36; Grade 1; with strike that suits frame.

## 2.8 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.

b. Allegion plc.
c. Door Controls International, Inc.
d. Hager

## 2.9 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic Flush Bolts: BHMA A156.3, Type 25; minimum 3/4-inch throw; with dust-proof strikes; designed for mortising into door edge. Include wear plates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
b. Allegion plc.
c. Door Controls International, Inc.
d. Hager

## 2.10 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
b. SARGENT Manufacturing Company; ASSA ABLOY.
c. Yale

## 2.11 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

## 2.12 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. Existing System:

a. Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver.

## 2.13 KEY CONTROL SYSTEM

A. Key Lock Boxes: Designed for storage of 20 keys.

## 2.14 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Hager Companies.
c. Hiawatha, Inc; a division of the Activar Construction Products Group.

## 2.15 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: BHMA A156.22.

## 2.16 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
b. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
c. SARGENT Manufacturing Company; ASSA ABLOY.

## 2.17 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

## 2.18 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg, as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot of door opening.

## 2.19 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Pemko Manufacturing Co.
c. Reese Enterprises, Inc.
d. Rixson Specialty Door Controls; an ASSA ABLOY Group company.

## 2.20 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Hager Companies.
c. Hiawatha, Inc; a division of the Activar Construction Products Group.
d. Pawling Corporation.

## 2.21 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the

door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:

   a. Wood or Machine Screws: For the following:

      1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      2) Strike plates to frames.
      3) Closers to doors and frames.

   b. Steel Through Bolts: For the following unless door blocking is provided:

      1) Surface hinges to doors.
      2) Closers to doors and frames.
      3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.22 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

## 3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings and to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.

E. Key Control System:
1. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.

F. Boxed Power Supplies: Locate power supplies in equipment/data room access control panel. Verify location with Architect.

1. Configuration: Provide centrally located (in Data Room) power supply with power supplies sized to operate all the electrified door hardware.

G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Project Acceptance.

3.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.7 DOOR HARDWARE SCHEDULE

**Door Hardware Set No. 1**

**Exterior Aluminum Doors-Secured***

| | | | | |
|---|---|---|---|---|
| 2 | Cont. Hinge (Electrified) | Hager, 14 GA | 780-111HD-ETW | |
| 2 | Exit Device w/ELR | Corbin-Russwin | ED5400-MELR-08-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Automatic Door Operator | LCN 4690 | | 630 |
| 2 | HC Actuators (Wired) | | | |
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 1 | Card Reader (Provided and installed by Owner) | Provide all low-voltage wring to location. | | |
| 2 | Door Contacts | Provide all low-voltage wring to location. | Provide generic in frame door contact. | |

**Door Hardware Set No. 2**

**Exterior Aluminum Doors-Secured***

| | | | | |
|---|---|---|---|---|
| 2 | Cont. Hinge (Electrified) | Hager, 14 GA | 780-111HD-ETW | |
| 2 | Exit Device w/ELR (Exit Only) | Corbin-Russwin | ED5400-MELR-Exit Only | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |

| | | | | |
|---|---|---|---|---|
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 2 | Door Contacts | | | |

**Door Hardware Set No. 3**

**Exterior Aluminum Doors-Secured***

| | | | | |
|---|---|---|---|---|
| 1 | Cont. Hinge (Electrified) | Hager, 14 GA | 780-111HD-ETW | |
| 1 | Exit Device w/ELR (Exit Only) | Corbin-Russwin | ED5200-MELR-Exit Only | 630 |
| 1 | Automatic Door Operator | LCN 4690 | | 630 |
| 2 | HC Actuators (Wired) | | | |
| 2 | Motion Sensor | | 1 Both Sides of Door | |
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 2 | Door Contacts | | | |

**Door Hardware Set No. 4**

**Exterior Aluminum Doors**

| | | | | |
|---|---|---|---|---|
| 2 | Cont. Hinge (Electrified) | Hager, 14 GA | 780-111HD-ETW | |
| 2 | Exit Device w/ELR | Corbin-Russwin | ED5400-MELR-08-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Automatic Door Operator | LCN 4690 | | 630 |
| 2 | HC Actuators (Wired) | | | |
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |

**Door Hardware Set No. 5**

**Exterior Aluminum Doors**

| | | | | |
|---|---|---|---|---|
| 1 | Cont. Hinges | Hager, 14 GA | 780-11HD | 304 |
| 1 | Exit Device | Corbin-Russwin | ED5400-08-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |

**Door Hardware Set No. 6**

**Exterior Aluminum Doors**

| | | | | |
|---|---|---|---|---|
| 1 | Cont. Hinge (Electrified) | Hager, 14 GA | 780-111HD-ETW | |
| 1 | Exit Device w/ELR | Corbin-Russwin | ED5400-MELR-08-ASM | 630 |
| 1 | Automatic Door Operator | LCN 4690 | | 630 |
| 2 | HC Actuators (Wired) | | | |
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |

**Door Hardware Set No. 7**

**Exterior Aluminum Doors-Secured- Exit Only***

| | | | | |
|---|---|---|---|---|
| 1 | Cont. Hinges | Hager, 14 GA | 780-11HD | 304 |
| 1 | Exit Device- Exit Only | Corbin-Russwin | ED5200-08 | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 1 | Door Contact | Provide all low-voltage wring to location. | | |

**Door Hardware Set No. 8**

**Pair Exterior Aluminum/FRP Doors***

| | | | | |
|---|---|---|---|---|
| 2 | Cont. Hinges | Hager, 14 GA | 780-111HD | 304 |
| 2 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Mortise Lockset-Storage | Corbin-Russwin | ML2057-ASM-M25 | 630 |
| 1 | Automatic Flush Bolt | | | |
| 1 | Coordinator | | | |
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 2 | Door Contact | Provide all low-voltage wring to location. | | |

**Door Hardware Set No. 9**

**Exterior Aluminum Doors- Exit Only***

| | | | | |
|---|---|---|---|---|
| 2 | Cont. Hinges | Hager, 14 GA | 780-11HD | 304 |
| 2 | Exit Device- Exit Only | Corbin-Russwin | ED5200-08 | 630 |
| 2 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 2 | Door Contact | Provide all low-voltage wring to location. | | |

**Door Hardware Set No. 10**

**Exterior Aluminum Doors-Secured***

| | | | | |
|---|---|---|---|---|
| 2 | Cont. Hinge (Electrified) | Hager, 14 GA | 780-111HD-ETW | |
| 2 | Exit Device w/ELR | Corbin-Russwin | ED5400-MELR-08-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 1 | Card Reader (Provided and installed by Owner) | Provide all low-voltage wring to location. | | |
| 2 | Door Contacts | Provide all low-voltage wring to location. | Provide generic in frame door contact. | |

**Door Hardware Set No. 11**

**Exterior Aluminum Doors-Secured***

| | | | | |
|---|---|---|---|---|
| 1 | Cont. Hinge (Electrified) | Hager, 14 GA | 780-111HD-ETW | |
| 1 | Exit Device w/ELR | Corbin-Russwin | ED5400-MELR-08-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 1 | Card Reader (Provided and installed by Owner) | Provide all low-voltage wring to location. | | |
| 1 | Door Contacts | Provide all low-voltage wring to location. | Provide generic in frame door contact. | |

**Door Hardware Set No. 12**

**Exterior Aluminum FRP Doors-Exit Only***

| | | | | |
|---|---|---|---|---|
| 1 | Cont. Hinges | Hager, 14 GA | 780-11HD | 304 |
| 1 | Exit Device- Exit Only | Corbin-Russwin | ED5200-08 | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Threshold | Hager | 520S | |
| 1 | Door Contact | Provide all low-voltage wring to location. | | |

**Door Hardware Set No. 13**

**Aluminum Doors-Secured***

| | | | | |
|---|---|---|---|---|
| 1 | Cont. Hinge (Electrified) | Hager, 14 GA | 780-111HD-ETW | |
| 1 | Exit Device w/ELR | Corbin-Russwin | ED5400-MELR-08-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | Corbin Russwin | | |
| 1 set | Weatherstrip | By Alum. /FRP Manuf. | | |
| 1 | Card Reader (Provided and installed by Owner) | Provide all low-voltage wring to location. | | |
| 1 | Door Contacts | Provide all low-voltage wring to location. | Provide generic in frame door contact. | |

**Door Hardware Set No. 14**

**Interior Wood Doors & Metal Frame- Fire-rated**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½" x 4 ½" | |
| 1 | Exit Device | Corbin-Russwin | ED5200A-08-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 1 | Kickplates | Hager, 12"x1"LDW | | |

**Door Hardware Set No. 15**

**Interior Wood Doors & Metal Frame- Fire-rated**

| | | | | |
|---|---|---|---|---|
| 0.5 | Pr. Hinges (Electrified) | Hager | HT BB1168-ETW, 4 ½" x 4 ½" | |
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½" x 4 ½" | |
| 1 | Mortise Lockset | Corbin-Russwin | ML20906xSECxASM | 630 |

| | | | | |
|---|---|---|---|---|
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | Corbin Russwin | | |
| 1 | Card Reader (Provided and installed by Owner) | Provide all low-voltage wring to location. | | |

**Door Hardware Set No. 16**

**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1262, 4 ½" x 4 ½" | |
| 1 | Push/Pull | Hager | #5 Push/23Q Pull | 630 |
| 1 | Closer | Corbin-Russwin | DC6200 | 689 |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplate, 12"x1"LDW | | | 630 |

**Door Hardware Set No. 17**

**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½" x 4 ½" | |
| 1 | Lockset – Storage | Corbin-Russwin | ML2057-ASM-M25 | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplates | Hager, 12"x1"LDW | | |

**Door Hardware Set No. 18**

**Interior Wood Doors & Metal Frame- Fire-rated**

| | | | | |
|---|---|---|---|---|
| 0.5 | Pr. Hinges (Electrified) | Hager | HT BB1168-ETW, 4 ½" x 4 ½" | |
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½" x 4 ½" | |
| 1 | Mortise Lockset | Corbin-Russwin | ML20906xSECxASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | Corbin Russwin | | |
| 1 | Card Reader (Provided and installed by Owner) | Provide all low-voltage wring to location. | | |

**Door Hardware Set No. 19**

**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 0.5 | Pr. Hinges (Electrified) | Hager | HT BB1168-ETW, 4 ½" x 4 ½" | |
| 2.5 | Pr. Hinges | Hager | HT BB1168, 4 ½" x 4 ½" | |
| 2 | Exit Device | Corbin-Russwin | ED5470xED5470MELR-08-ASM | 630 |
| 2 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 2 | Wall Bumper | Hager | 234D | |
| 4 | Kickplates | Hager, 12"x1"LDW | | |

**Door Hardware Set No. 20**

**Interior Wood Doors & Metal Frame- Fire-rated.**

| | | | |
|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½" x 4 ½" |

| | | | | |
|---|---|---|---|---|
| 1 | Lockset – Storage | Corbin-Russwin | ML2057-ASM-M25 | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 21**

**Pair Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 3 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 2 | Exit Device | Corbin-Russwin | ED5400xED5400-08ASM | 630 |
| 2 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 2 | Wall Bumper | Hager | 234D | |
| 4 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 22**

**Pair Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | Exit Device | Corbin-Russwin | ED5400xED5400-08ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 23**

**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | Lockset - Office | Corbin-Russwin | ML2051-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 24**

**Interior Wood Doors & Metal Frame-Secured**

| | | | | |
|---|---|---|---|---|
| 0.5 | Pr. Hinges (Electrified) | Hager | HT BB1168-ETW, 4 ½” x 4 ½” | |
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | EC Mortise Lockset | Corbin-Russwin | ML20903-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | Corbin Russwin | | |
| 1 | Card Reader (Provided and installed by Owner) | Provide all low-voltage wring to location. | | |
| 1 | Wall Bumper | Hager | 234D | |

**Door Hardware Set No. 25**

**Interior Wood Doors & Metal Frame**

| | | | |
|---|---|---|---|
| 3 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” |

| | | | | |
|---|---|---|---|---|
| 1 | Lockset – Storage | Corbin-Russwin | ML2057-ASM-M25 | 630 |
| 1 | Automatic Flush Bolt | | | |
| 1 | Coordinator | | | |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 26**
**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | Lockset – Storage | Corbin-Russwin | ML2057-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 27**
**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | Lockset – Storage | Corbin-Russwin | ML2057-ASM-M25 | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |

**Door Hardware Set No. 28**
**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1262, 4 ½” x 4 ½” | |
| 1 | Lockset - Passage | Corbin-Russwin | ML2010-ASM | 630 |
| 1 | Closer | Corbin-Russwin | DC6200 | 689 |

**Door Hardware Set No. 29**
**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | Exit Device | Corbin-Russwin | ED5400xED5400-08ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 1 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 30**
**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 3 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | Lockset – Storage | Corbin-Russwin | ML2057-ASM-M25 | 630 |
| 1 | Automatic Flush Bolt | | | |

| | | | | |
|---|---|---|---|---|
| 1 | Coordinator | | | |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 31**

**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1 | Cont. Hinge | Hager, 14 GA | 780-111HD | |
| 1 | Lockset - Office | Corbin-Russwin | ML2051-ASM | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |

**Door Hardware Set No. 32**

**Interior Wood Doors in Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | Lockset – Storage | Corbin-Russwin | ML2057-ASM-M25 | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 2 | Kickplates | Hager, 12”x1”LDW | | |

**Door Hardware Set No. 33**

**Interior Wood Doors & Metal Frame**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1262, 4 ½” x 4 ½” | |
| 1 | Lockset - Privacy | Corbin-Russwin | ML2060-ASM-V20 | 630 |
| 1 | Closer | Corbin-Russwin | DC6200 | 689 |
| 1 | Wall Bumper | Hager | 234D | |
| 2 | Kickplate, 12”x1”LDW | | | 630 |

**Door Hardware Set No. 34**

**Interior Wood Doors & Metal Frame- Fire-rated**

| | | | | |
|---|---|---|---|---|
| 1.5 | Pr. Hinges | Hager | HT BB1168, 4 ½” x 4 ½” | |
| 1 | Exit Device | Corbin-Russwin | ED5200A-08-ASM-M25 | 630 |
| 1 | Closers | Corbin-Russwin | DC6210xA1 | 689 |
| 1 | Cylinder | | | |
| 1 | Wall Bumper | Hager | 234D | |
| 1 | Kickplates | Hager, 12”x1”LDW | | |

**END OF SECTION 087100**

**SECTION 088000 - GLAZING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites, storefront framing, glazed curtain walls.
2. Glazing sealants and accessories.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches square.

1. Tinted glass.
2. Coated glass.
3. Insulating glass.
4. Spandral glass.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For glass.

C. Product Test Reports: For tinted glass, coated glass, insulating glass, and glazing sealants, for tests performed by a qualified testing agency.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## 1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

## 1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Project Acceptance.

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. GGI; General Glass International.
    b. Vitro Architectural Glass, Inc.
    c. Vetrotech Saint-Gobain.
    d. Viracon, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.
2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

### 2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the NC Building Code 2018 and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
2. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
3. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
4. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

## 2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.

E. Ceramic-coated, low-E, insulating spandrel glass.

## 2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
2. Spacer: Aluminum with mill or clear anodic finish.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
4. Sealants shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

## 2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

## 3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

## 3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

## 3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

## 3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Project Acceptance. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.9 INSULATING GLASS SCHEDULE

A. Glass Type: Low-E-coated, tinted insulating glass.

1. Basis-of-Design Product: Vitro Architectural Glass, Solarban 70XL Solargray + Clear
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted fully tempered float glass.
5. Tint Color: Solargray (Gray).
6. Interspace Content: Manufacturer’s Standard.
7. Indoor Lite: Clear fully tempered float glass.
8. Low-E Coating: Sputtered on second surface.
9. Winter Nighttime U-Factor: 0.28 maximum.
10. Summer Daytime U-Factor: 0.26 maximum.
11. Visible Light Transmittance: 58% percent minimum.
12. Solar Heat Gain Coefficient: 0.27 maximum.
13. Light to Solar Gain (LSG); 2.15
14. Safety glazing required.

B. Glass Type: Ceramic-coated, low-E, insulating spandrel glass.

1. Basis-of-Design Product: Spandrelite
2. Coating Color: As selected by Architect from manufacturer's full range to match Insulated Glass
3. Overall Unit Thickness: 1 inch.
4. Minimum Thickness of Each Glass Lite: 6 mm.
5. Outdoor Lite: Ultraclear fully tempered float glass.
6. Interspace Content: Manufacturer’s Standard.
7. Indoor Lite: Fully tempered float glass.
8. Low-E Coating: Sputtered on second surface.
9. Opaque Coating Location: Fourth surface.
10. Winter Nighttime U-Factor: 0.28 maximum.
11. Summer Daytime U-Factor: 0.26 maximum.

**END OF SECTION 088000**

**SECTION 088300 - MIRRORS**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:
   1. Tempered glass mirrors qualifying as safety glazing.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

   1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

C. Samples: For each type of the following products:

   1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
   2. Mirror Clips: Full size.
   3. Mirror Trim: 12 inches long.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

### 1.5 QUALITY ASSURANCE

A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

B. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

C. Glazing Publications: Comply with the following published recommendations:

   1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.

D. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

**PART 2 - PRODUCTS**

2.1 SILVERED FLAT GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

B. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.

1. Nominal Thickness: 5.0 mm

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. Adhesive shall have a VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE

A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.05 inch.

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.062 inch.

3. Finish: Clear bright anodized.

B. Plated Steel Hardware: Formed-steel shapes with plated finish indicated.

C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

D. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

A. Mirror Sizes: To suit Project conditions, and before tempering, cut mirrors to final sizes and shapes.

B. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Rounded polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Provide a minimum air space of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Wall-Mounted Mirrors: Install mirrors with mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
2. Install mastic as follows:

    a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
    b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
    c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Project Acceptance. Wash mirrors as recommended in writing by mirror manufacturer.

**END OF SECTION 088300**

## SECTION 088813 - FIRE-RESISTANT GLAZING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Fire-protection-rated glazing.

### 1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

### 1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

### 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers.

B. Product Certificates: For each type of glass and glazing product, from manufacturer.

C. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during the remainder of the construction period.

1.10 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

## 2.4 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.

C. Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

## 2.5 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.

1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.

C. Laminated Ceramic Glazing: Laminated glass made from two plies of clear, ceramic glass; 8-mm total thickness; and complying with 16 CFR 1201, Category II.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGC Glass Company North America, Inc.
b. SAFTI FIRST Fire Rated Glazing Solutions.
c. Schott North America, Inc.
d. Technical Glass Products.
e. Vetrotech Saint-Gobain (Basis for Design- KERALITE LAMINATED 45)

## 2.6 GLAZING ACCESSORIES

A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing

agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

1. Sealants shall have a VOC content of 250 g/L or less.
2. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.

C. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

C. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

## 2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate the fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed work.

### 3.3 GLAZING, GENERAL

A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

B. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

## 3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

## 3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial washaway from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Project Acceptance. Wash glass as recommended in writing by glass manufacturer.

**END OF SECTION 088813**

## SECTION 088853 - SECURITY GLAZING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes:

1. Laminated-glass security glazing
2. Polycarbonate security glazing.

### 1.2 DEFINITIONS

A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.

### 1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of glass tint.

C. Samples for Verification:

1. Glazing: Actual sample of finished products for each type of security glazing.
2. Size: Manufacturers' standard size.

D. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.

### 1.5 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports:

a. For each type of security glazing, for tests performed by qualified testing agency.

b. For each type of glazing sealant, for tests performed by a qualified testing agency.

1) Provide test reports based on testing current sealant formulations within previous 36-month period.

2. Preconstruction Test Reports: For preconstruction adhesion and compatibility testing.

B. Sample warranties.

## 1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: For insulating or air-gap security glazing units with sputter-coated, low-e coatings, a qualified insulating glazing manufacturer who is approved and certified by coated-glass manufacturer.
2. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.
3. Security Glazing Testing Agency: Subject to compliance with requirements, testing agency is one of the following:

a. Intertek.
b. Underwriters Laboratories, Inc.
c. Wiss, Janney, Elstner Associates, Inc.

4. Sealant Testing Agency: An independent testing agency qualified in accordance with ASTM C1021 to conduct the testing indicated.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## 1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Special Warranty, Monolithic Polycarbonate Security Glazing: Manufacturer agrees to replace monolithic polycarbonate security glazing that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Defects developed from normal use that are not attributed to maintaining and cleaning monolithic polycarbonate security glazing contrary to manufacturer's written instructions. Defects include yellowing and loss of light transmission.

2. Warranty Period: 10 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 SOURCE LIMITATIONS

A. Obtain each type of security glazing from single source from single manufacturer.

2.2 POLYCARBONATE SECURITY GLAZING

A. Monolithic Polycarbonate Security Glazing: ASTM C1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on exposed surfaces and Type I, standard, UV-stabilized polycarbonate where no surfaces are exposed.

2.3 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of Industry colors.

2.4 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of security glazing and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

2.5 FABRICATION OF SECURITY GLAZING

A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Grind smooth and polish exposed security glazing edges and corners.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine framing for security glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Minimum required bite.
5. Effective sealing between joints of framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of it off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.

F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness of slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and in accordance with requirements in referenced glazing publications.

H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set coated security glazing with proper orientation so that coatings and films face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

## 3.4 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. Examine security glazing surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.

C. Wash security glazing on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

## 3.5 MONOLITHIC POLYCARBONATE SECURITY GLAZING SCHEDULE

A. Security Glazing: Monolithic polycarbonate with mar-resistant coating on both surfaces.
   1. Detention Security Grade: Grade 4 in accordance with ASTM F1915 cold-temperature impact test, warm-temperature impact test and torch and small blunt impactor test.
   2. Thickness: 1/2 inch.

**END OF SECTION 088853**

## SECTION 089119 - FIXED LOUVERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Fixed extruded-aluminum louvers.
2. Blank-off panels for louvers

### 1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

### 1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Sample Warranties: For manufacturer's special warranties.

### 1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Airline Louvers; a division of Mestek, Inc.
b. Airolite Company, LLC (The).
c. Arrow United Industries.
d. Construction Specialties, Inc.
e. Greenheck Fan Corporation.
f. Louvers & Dampers, Inc.; a division of Mestek, Inc.
g. Ruskin Company.

2. Louver Depth: 4 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

a. Free Area: Not less than 8.0 sq. ft. for 48-inch-wide by 48-inch-high louver and/or as indicated on the Mechanical/HVAC Drawings
b. Point of Beginning Water Penetration: Not less than 1000 fpm.
c. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area exhaust velocity.
d. Air Performance: Not more than 0.15-inch wg static pressure drop at 1000-fpm free-area intake velocity.
e. See Mechanical Drawings for Louver Schedule, Final Sizes, and Free Area Requirements.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

## 2.3 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screen for intake louver, Insect screening for relief/exhaust louvers.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.
2. Insect Screening, Aluminum: 18-by-16 mesh, 0.012-inch wire.

## 2.4 BLANK-OFF PANELS

A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 1 inch.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same type of finish applied to louvers, but black color.
7. Attach blank-off panels with clips or sheet metal screws.

## 2.5 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Exterior Corners: Prefabricated corner units with mitered blades with concealed close-fitting splices and with fully recessed mullions at corners.

G. Provide subsills made of same material as louvers for recessed louvers.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

## 3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

## 3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

**END OF SECTION 089119**

## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

## PART 2 - PRODUCTS

### 2.1 DESCRIPTION

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **25** percent.

### 2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized, unless otherwise indicated.

B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.018 inchU.N.O.
b. Depth: As indicated on Drawings

2. Dimpled Steel Studs and Runners:

a. Minimum Base-Metal Thickness: As indicated on Drawings or 0.015 inch.
b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: As indicated on Drawings or 0.018 inch.

F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: 7/8 inch.

## 2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

1. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch-wide flanges.

1. Depth: 2-1/2 inches.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.018 inch.
b. Depth: 2-1/2 inches.

3. Dimpled Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.015 inch.
b. Depth: 2-1/2 inches.

4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base-Metal Thickness: 0.018 inch.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

## 3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

## 3.4 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

a. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
b. Multilayer Application: 16 inches o.c. unless otherwise indicated.
c. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

D. Direct Furring:
1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

## 3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

**END OF SECTION 092216**

**SECTION 092900 - GYPSUM BOARD**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Acoustically enhanced gypsum board.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives and sealants, indicating VOC content.
3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-emitting materials.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

### 1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

### 1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### 2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

C. Regional Materials: Manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

D. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. National Gypsum Company.
5. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.

2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

## 2.4 SPECIALTY GYPSUM BOARD

A. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

B. Acoustically Enhanced Gypsum Board: ASTM C1766. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.

1. Core: 5/8 inch, regular type.
2. Long Edges: Tapered.

## 2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; GlasRoc Sheathing.
b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond, e(2)XP.
d. USG Corporation; Securock Glass Mat Sheathing.

2. Core: 5/8 inch.

## 2.6 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Thickness: 5/8 inch.
2. Mold Resistance: ASTM D 3273, score of 10.

## 2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.

b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. L-Bead: L-shaped; exposed long flange receives joint compound.
d. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.8 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:
1. Cementitious Backer Units: As recommended by backer unit manufacturer.

## 2.9 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 40 percent.

D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
b. Grabber Construction Products; Acoustical Sealant GSC.
c. Pecora Corporation; AC-20 FTR.
d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
e. USG Corporation; SHEETROCK Acoustical Sealant.

2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

## 3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: Vertical surfaces unless otherwise indicated.
2. Type X: Where required for fire-resistance-rated assembly.
3. Cementitious backer board: Behind all ceramic tile locations

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing

members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

## 3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

## 3.5 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

## 3.6 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.

D. Aluminum Trim: Install in locations indicated on Drawings.

## 3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.

3. Level 5: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in other Division 09 Sections.

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION 092900**

**SECTION 093013 - CERAMIC TILING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceramic mosaic tile.
2. Porcelain tile.
3. Stone thresholds.
4. Waterproof membrane.
5. Crack isolation membrane.
6. Metal edge strips.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Stone thresholds in 6-inch lengths.
5. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Waterproof membrane.

## 2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

## 2.3 TILE PRODUCTS

A. Ceramic Tile (CT1) Ceramic Floor Tile

1. Basis of Design: Caesar Ceramics USA, “Pathway” collection, or provide a comparable product by one of the following:

a. Caesar Ceramics USA (Basis of Design)
b. Tile Bar
c. Trinity Tile

2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
3. Module Size: 12 inches by 12 inches.
4. Thickness: 9 millimeters.
5. Face: Plain with cushion edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color and Pattern: As indicated by the Architect, selecting from the full range of styles and patterns available within the collection.
8. Grout Color: As selected by the Architect from the manufacturer's full range.

Ceramic Tile (CT2) Ceramic Wall Tile

1. Basis of Design: Caesar Ceramics USA, “Pathway” collection, or provide a comparable product by one of the following:

    a. Caesar Ceramics USA (Basis of Design)
    b. Tile Bar
    c. Trinity Tile

2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
3. Module Size: 24 inches by 48 inches.
4. Thickness: 9 millimeters.
5. Face: Plain with cushion edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color and Pattern: As indicated by the Architect, selecting from the full range of styles and patterns available within either collection.
8. Grout Color: As selected by the Architect from the manufacturer's full range.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
    a. External Corners: Metal trim by Schluter (anodized aluminum), Basis of Design: Rondec.
    b. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

C. Ceramic Tile (CT3) Ceramic Wall Tile

1. Basis of Design: Tilebar, “Brookline” collection, or provide a comparable product by one of the following:

    a. Tile Bar (Basis of Design)
    b. Caesar Ceramics USA
    c. Trinity Tile

2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
3. Module Size: 2 inch by 7 inch Fish Scale Glossy Ceramic Mosaic Tile.
4. Thickness: 9mm.
5. Face: Plain with cushion edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color and Pattern: As indicated by the Architect, selecting from the full range of styles and patterns available within either collection.
8. Grout Color: As selected by the Architect from the manufacturer's full range.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
    a. External Corners: Metal trim by Schluter (anodized aluminum), Basis of Design: Rondec.
    b. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

D. Ceramic Tile (CT4) Ceramic Wall Tile

1. Basis of Design: Tilebar, “Remington” collection, or provide a comparable product by one of the following:

    a. Tile Bar (Basis of Design)

b. Caesar Ceramics USA
c. Trinity Tile

2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
3. Module Size: 2 inch by 6 inch Midnight Blue 3D Mixed Finish Glass Subway Tile.
4. Thickness: 8mm.
5. Face: Plain with cushion edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color and Pattern: As indicated by the Architect, selecting from the full range of styles and patterns available within either collection.
8. Grout Color: As selected by the Architect from the manufacturer's full range.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
   a. External Corners: Metal trim by Schluter (anodized aluminum), Basis of Design: Rondec.
   b. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

## 2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 10 according to ASTM C1353 or ASTM C241/C241M and with honed finish.

1. Description:

   a. Uniform, black stone.
   b. Match Architect's sample.

## 2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with fabric reinforcement facing; 0.040-inch nominal thickness.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Boiardi Products Corporation; a QEP company.
   b. Custom Building Products.
   c. H.B. Fuller Construction Products Inc. / TEC.
   d. National Applied Construction Products, Inc.

C. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both waterproofing and tile-setting adhesive in a two-step process.

1. Verify adhesives have a VOC content of 65 g/L or less.

## 2.6 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils thick.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A185/A185M and ASTM A82/A82M, except for minimum wire size.
3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

## 2.7 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

## 2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic, designed specifically for flooring and corner applications; exposed-edge material.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Blanke Corporation.
b. Ceramic Tool Company, Inc.
c. Schluter Systems L.P.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and

match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

## 3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Tile floors in wet areas.
    b. Tile floors consisting of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: Standard sheet size spacing
2. Porcelain Tile: 1/4 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
2. Do not extend cleavage membrane waterproofing under thresholds set in modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane or waterproofing with elastomeric sealant.

## 3.4 TILE BACKING PANEL INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

## 3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

## 3.6 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

## 3.7 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor including Shower Pan:

1. Ceramic Tile Installation: TCNA F121 and ANSI A108.1B; cement mortar bed (thickset) on waterproof membrane.

a. Ceramic Tile Type: CT.
b. Bond Coat for Cured-Bed Method: Latex- portland cement mortar.
c. Grout: Water-Cleanable Epoxy Grout.
d. Location: As noted.
e. Fabric-Reinforced, Modified-Bituminous Sheet to 4” above finished floor.
f. Cleavage Membrane.

2. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.

a. Ceramic Tile Type: CT.
b. Thinset Mortar: Latex- portland cement mortar.
c. Grout: Water-Cleanable Epoxy Grout.
d. Location: As noted.
e. Fabric-Reinforced, Modified-Bituminous Sheet to 4” above finished floor.

B. Interior Wall Installations, Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units.

a. Ceramic Tile Type: CT.
b. Thinset Mortar: Latex- portland cement mortar.
c. Grout: Water-Cleanable Epoxy Grout.

**END OF SECTION 093013**

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Samples for Initial Selection: For components with factory-applied finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

### 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.
2. Smoke-Developed Index: 450 or less.

2.3 ACOUSTICAL PANELS

A. Basis of Design Product: Subject to compliance with requirements, provide Armstrong World Industries, “Cirrus Tegular High NRC #556”, or comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. Tectum Inc.
5. USG Interiors, Inc.; Subsidary of USG Corporation

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

1. Type and Form: Type III, mineral base with painted finish; Form 1, nodular.
2. Pattern: E (Lightly textured).

C. Color: White.

D. Light Reflectance (LR): Not less than 0.85.

E. Ceiling Attenuation Class (CAC): Not less than 35.

F. Noise Reduction Coefficient (NRC): Not less than 0.75.

G. Edge/Joint Detail: Beveled, Tegular.

H. Thickness: 3/4 inch.

I. Modular Size: 24 by 24 inches.

J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.4 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.

B. Wide-Face, Single-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled 15/16 inch steel sheet electrolytically zinc coated, with prefinished flanges of width indicated.
   1. Structural Classification: Heavy-duty system.
   2. Face Finish: Painted white.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

   1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

   1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch-diameter wire.

E. Hanger Rods Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. Gordon, Inc.
5. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.6 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of the following

1. Acoustical Sealant for Concealed Joints:

a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
b. Pecora Corporation; AIS-919.
c. Tremco, Inc.; Tremco Acoustical Sealant.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

## 3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

**END OF SECTION 095113**

**095114-WOOD LINEAR VENEERED CEILING ASSEMBLY**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

### 1.2 SUMMARY

a) Section Includes:

1. Wood Linear Veneered Closed
2. Concealed grid suspension system.
3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

### 1.5 QUALITY ASSURANCE

a) Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.

b) Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: As follows, tested per ASTM E-84 and complying with ASTM E 1264 for Class A products.
2. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.

c) Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.

d) Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

### 1.6 DELIVERY, STORAGE, AND HANDLING

a) Store ceiling components in a dry interior location in their cartons prior to installation to avoid damage. Store cartons in a flat, horizontal position. The protectors between the panels should not be removed until installation.

b) Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Panels must not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.

c) Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

### 1.7 PROJECT CONDITIONS

a) Wood ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).

b) The wood panels should not be installed in spaces where the temperature or humidity conditions vary from the temperatures and conditions that will be normal in the occupied space.

c) As interior finish products, the veneered panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed, and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

### 1.8 WARRANTY

a) Veneered Wood Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:

1. Veneered Wood Panels: Defects in materials or factory workmanship.
2. Grid System: Rusting and manufacturing defects.

b) Warranty Period:

1. Veneered Wood panels: One (1) year from date of installation.
2. Grid: Ten years from date of installation.

c) The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

**1.9 MAINTENANCE**

a) Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Ceiling Units: Furnish quality of full-size units equal to 2.0 percent of amount installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

a) Basis of Design Wood Linear Veneered & Suspension System:

1. Armstrong World Industries, Inc. (Basis of Design; WoodWorks, Concealed)

**2.2.0 WOOD CEILING UNITS**

a) EWood Veneer Ceiling Panels:

- Surface Texture: Smooth
- Composition: Real wood veneer on fire rated particle board
- Finish(s): Real Wood Veneer
    - Plain Slice White Maple (NWM)

Panel Width Size(s): As indicated.

- 6-inch (O.C.): 5-1/4-inch Plank Width (Actual)

Panel Length Size(s): With no reveal @ Length

- 96-inch (Actual)

b) Accessories:

1. Mounting Clip – Item 5389
2. Spring Border Clips- Item 7870
3. Adjustable Trim Clip - Item 7239
4. Replacement Trim Clip – Item 5925
5. Heavy-duty Wall Anchor (seismic) – Item 7100

**2.2.1 SUSPENSION SYSTEMS**

c) Components: Manufacturer’s standard concealed system.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

a) Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.

b) Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

**3.2 PREPARATION**

a) Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

b) WoodWorks ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).

**3.3 INSTALLATION**

a) Interior WoodWorks products, the veneered wood panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed, and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

b) Install suspension system and panels in compliance with ASTM C636, ASTM E580, with the approval of the authorities having jurisdiction, and in accordance with the manufacturer's WoodWorks Linear Veneered Panels Installation Instructions.

**3.4 ADJUSTING AND CLEANING**

a) Replace damaged and broken panels.

b) Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

**END OF SECTION 095114**

**SECTION 095115- INTEGRATED ACCOUSTICAL CEILING ASSEMBLIES**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

**1.2 SUMMARY**

a) Section Includes

1) Acoustical ceiling panel

2) Wire hangers, fasteners, main runners, cross tees, and wall angle moldings

3) Perimeter Trim

4) Access Panels

**1.4 SYSTEM DESCRIPTION**

Continuous/Wall-to-Wall or Cloud installation

**1.5 SUBMITTALS**

a) **Shop Drawings:** Layout and details of ceilings. Show locations of items that are to be coordinated with, or supported by the ceilings.

b) **Installation Instructions:** Submit manufacturer's installation instructions as referenced in Part three, Installation.

c) **Product Data:** Submit manufacturer's technical data for each type of ceiling unit, suspension system and access panel required.

d) **Samples:** Minimum 6 x 6 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

e) **Certifications:** Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

f) **Non-Conformance:** All products not conforming to the requirements of this specification and or the manufacturer's published values are to be disposed. The Contractor performing the work will replace with approved product at their expense.

**1.6 QUALITY ASSURANCE**

a) Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

b) Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

c) Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

d) Acoustical Panels: As with other architectural features located at the ceiling that may obstruct or skew the planned fire sprinkler pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the

device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

e) Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers. AcoustiBuilt Panels are 7/8" thick.

f) Installer Qualification: Subcontractor is an experienced Installer that has reviewed and understands the system installation instructions thoroughly. Subcontractor will follow written installation instructions and utilize approved equipment and procedures for finishing installation.

g) AcoustiBuilt is finished to a level 4 drywall finish equivalent. Installing AcoustiBuilt requires special attention to finishing details. Light coves and low angle lighting will exaggerate imperfections. Mock-ups and hands-on training are strongly recommended.

**1.8 DELIVERY, STORAGE AND HANDLING**

a) Deliver acoustical ceiling units to project site in original, unopened packages/crates and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

b) Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content. Store all material within temperature limits required by manufacturer.

c) Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

**1.9 PROJECT CONDITIONS**

a) Space Enclosure:

1) Building areas to receive ceilings shall be free of construction dust and debris. AcoustiBuilt panels should be installed in areas where the building is enclosed and the HVAC is continuously functioning. This product is not recommended for exterior applications, where standing water is present, or where moisture will come into direct contact with the ceiling.

i. HVAC should be designed, installed, and operated in accordance with ASHRAE Standard 62.1. It is also necessary for the area to be enclosed, for the HVAC systems to be functioning, and in continuous operations for the life of the product. Product is not intended for use where natural ventilation is part of the ventilation strategy and not recommended in areas where a differential plenum pressure exists.

**1.10 WARRANTY**

a) Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Manufacturer's defects in material

2. Grid System: Rusting and manufacturer's defects

3. CastWorks Access Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period

b) Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion

2. Suspension: Ten (10) years from date of substantial completion

3. CastWorks Architectural Forms: One (1) year from date of substantial completion

c) The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

a) Basis of Design AcoustiBuilt Seamless Acoustical Ceiling System:

   a. Armstrong World Industries, Inc. or equal by CertainTeed Corp., Chicago Metallic Corporation, Tectum Inc., USG Interiors, Inc.; Subsidary of USG Corporation

b) Finish

   a. Joint Compound Finish by Others

   b. Armstrong World Industries, Inc. or equal by CertainTeed Corp., Chicago Metallic Corporation, Tectum Inc., USG Interiors, Inc.; Subsidary of USG Corporation

c) Suspension Systems

   a. Armstrong World Industries, Inc. or equal by CertainTeed Corp., Chicago Metallic Corporation, Tectum Inc., USG Interiors, Inc.; Subsidary of USG Corporation

d) Perimeter Trim Systems

   a. Armstrong World Industries, Inc. or equal by CertainTeed Corp., Chicago Metallic Corporation, Tectum Inc., USG Interiors, Inc.; Subsidary of USG Corporation

### 2.2.1 ACOUSTICAL CEILING UNITS

a) Acoustical Panels

   1) Surface Texture: Fine
   2) Composition: Mineral Fiber
   3) Color: White (Fine Texture Finish for AcoustiBuilt panels)
   4) Size: 48 in x 72 in x 7/8 in - Item #2604
   5) Edge Profile: Tapered edges four sides
   6) Noise Reduction Coefficient (NRC): ASTM C 423; Panel 0.80 (UL)
   7) Ceiling Attenuation Class (CAC): ASTM C 1414; Panel 46 (UL), System up to 48
   8) Sabin: Cloud Applications: 0.80 Sabins/SF & 1.33 Sabins/SF with infill item 8200T10
   9) Flame Spread: ASTM E 1264; Class A
   10) Light Reflectance (LR) White Panel: ASTM E 1477; 0.87
   11) Dimensional Stability: HumiGuard Plus
   12) Recycle Content: Post-Consumer and Pre-Consumer – up to 75%
   13) Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
   14) Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)
   15) Acceptable Product: AcoustiBuilt panels #2604 No added formaldehyde as manufactured by Armstrong World Industries or equal.

b) Finish

   1. Joint Compound

a. Setting Compound: Lightweight setting-type drywall joint compound, Ultra lightweight drying-type drywall joint compound

b. Joint Tape: Self-Adhesive mesh drywall joint tape (Panel to Panel)

1. Use Setting Type Compound for initial coats and use Drying Type Compound for final coats per the installation instructions. DO NOT use any other type of drywall compound such as All-Purpose Compound.

2. Paper tape at the wall intersection

2. Spray Applied Finish – Required Product: #2605WH or 2605BL Fine Texture Finish for AcoustiBuilt panels – White as manufactured by Armstrong World Industries or equal.

c) Suspension Systems

1. Drywall Suspension Systems all main beams and cross tees shall be commercial quality hot-dipped galvanized steel

i. Main beam: manufactured main beam- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-11/16 inches high. Drywall Main Beams are factory punched with cross tee routs, hanger wire holes, and SuperLock™ main beam clip for a strong secure connection and fast accurate alignment. Drywall Main Beams are Heavy-duty performance per ASTM C635

ii. HD8906 - 12ft HD Drywall Main Beam 1-1/2 in

2. Cross Tees: manufactured cross tee- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-1/2 inches high with factory punched cross tee routs and hanger wire holes and XL stake on clip for a strong secure connection.

i. XL8945P - 4ft Drywall Cross Tee

3. Wall Molding:

i. KAM12 - 12ft Knurled Angle Molding 1-1/4" Face

4. Hanger wire: a Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three times the design load, but not less than 12-gauge.

5. Fasteners (for Panel attachment)

i. #6 x 1-5/8” Fine thread drywall screws

ii. Recommended Adhesives: Loctite PL Premium Polyurethane Construction Adhesive, OSI F38 Drywall Panel Adhesive.

6. Perimeter Systems

i. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

1. Color: White

2. Size: 120 in X 4 in (also available in 6”)

3. Recycle Content: Post-Consumer - 50% Pre-Consumer - 0%

4. Acceptable Product: AXIOM One Piece for Drywall, 4in Straight – AX1PC4STR or Curved AX1PC4CUR as manufactured by Armstrong World Industries

ii. Axiom Trim Channel:

1. AX4STR 4in Axiom Classic Straight

2. AX1PC4STR 4IN One –Piece Drywall Trim

iii. Axiom Bottom Trim with taping flange

1. AXBTASTR – Bottom Trim for AcoustiBuilt (also available in curved)

iv. Axiom Accessories:

1. AXSPLICE - Splice Plate

## I. PART 3 - EXECUTION

a) If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

b) The system installation is similar to a conventional drywall installation. However, there are key differences in both material substrate and methods of finishing and installation that make this system unique.

c) Installation: In accordance with all approved plans, details, and manufacturer's installation guidelines located in the Manufacturers Installation Instructions

1. Install seismic components if required by the building code. Seismic components to be specified on the architectural plans by the project engineer or design team.
2. Suspend main beam from overhead construction with hanger wires spaced 4-0 ft. on center along the length of the main runner. Install hanger wires plumb and straight.
3. 48” Cross tees shall be installed 16” on center. Extra cross tees are required at 72” every 12’. All 4 panel edges must be supported by a grid main or tee.
4. Install wall moldings/perimeter trim at intersection of suspended ceiling and vertical surfaces
5. Main runners and cross tees shall be attached at perimeter conditions
6. When determining the grid layout, consider the long edges of the boards must run parallel with the mains.
7. This system relies on a square grid system to ensure panel edges align at centers of cross tees. If the installation does not meet these squareness requirements, the panel edges may run off the grid system.
    i. The system must be square to within 1/8" over a 48" x 48" module.
    ii. The suspension system must be leveled to within 1/4" in 10'.
8. Floating perimeters must be trimmed with either Axiom® One-Piece Drywall Trim or Axiom® Classic with Bottom Trim for AcoustiBuilt™.

### 3.2.1 PREPARATION

a) Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

b) Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

c) Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

### 3.2.3 INSTALLATION

A) Panel joints and fasteners are finished with tape and compound to create a flat surface. While the materials used to finish AcoustiBuilt panels are also used to finish drywall, the procedure has unique requirements.

B) Joint compound coverage shall be limited to preserve the acoustical performance of the panels. Compound at panel joints shall not exceed 8 inch widths. Compound applied to field fasteners shall not exceed 2 inch by 2-inch areas. All compound shall be smooth and free of tool marks and ridges. Panels

are to be finished with taping knives. Production tools, including boxes, are detailed on the installation instructions.

C) Sanding and inspection: Throughout the sanding process, inspect the surface frequently for flatness. Direct a light across the ceiling to highlight unevenness that requires attention.

D) Fine Texture Finish shall be applied in 4-5 coat process (additional coat may be used to achieve the desired finish) as called out in the installation instructions. Fine Texture Finish for AcoustiBuilt is applied in multiple coats, layered to achieve a uniform appearance and acoustical performance. It is strongly encouraged to practice spraying to ensure proper calibration and technique are achieved. Refer to the installation video.

I. AcoustiBuilt fine texture finish MUST be sprayed with a Graco Mark V texture system. This equipment properly atomizes the finish for acoustics and aesthetics. Fine texture finish is not intended for use with any other airless paint systems not recommended by manufacturer or to be applied by brush or rolling.

II. See Manufactures installation instructions for correct spray tip, pressure settings for spray system, finish preparation, spray calibration and spray procedure and technique.

### 3.2.4 ADJUSTING AND CLEANING

a) To remove soot, dirt, and dust use a vacuum operating at low power with a soft brush or use a dry soot cleaning sponge.

b) Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

**END OF SECTION 095115**

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.
3. Rubber stair treads.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Sourcing Raw Materials: Corporate sustainability report for each manufacturer.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

C. Samples for Initial Selection: For each type of product indicated.

D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

### 1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Project Acceptance, maintain ambient temperatures within range recommended by the manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 THERMOSET-RUBBER BASE

A. Product Standard: ASTM F 1861, NSF 332, Group I (solid, homogeneous).

B. Thickness: 0.125 inch.

C. Height: 5-1/4" inches.

D. Profile: Impulse #15 by Roppe (Basis of Design); or provide comparable product by Johnsonite or Armstrong.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Colors: As selected by Architect from full range of industry colors.

### 2.2 RUBBER MOLDING ACCESSORY

A. Description: Rubber carpet edge for glue-down applications, nosing for resilient flooring.

B. Locations: Provide rubber molding accessories at all changes in flooring material.

C. Colors and Patterns: As selected by Architect from full range of industry colors.

### 2.3 RESILIENT STAIR ACCESSORIES

A. Rubber Stair Treads (RT):
1. Classification: ASTM F2169, Type TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).
    a. Class: 2 (pattern; embossed).
    b. Group: 1 (embedded abrasive strips).
2. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
3. Nosing Height: 2 inches.
4. Thickness: 1/4 inch and tapered to back edge.

5. Size: Lengths and depths to fit each stair tread in one piece or one piece or, for treads exceeding maximum lengths manufactured, in equal-length units. Length of tread is 13”.

B. Integral Risers: Smooth, flat; in height that fully covers substrate.

C. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer who produced treads and recommended by manufacturer for installation with treads.

1. Style: Coved toe, 7 inches high by length matching treads.
2. Thickness: 0.125 inch.

D. Landing Tile: Matching treads; produced by same manufacturer who produced treads and recommended by manufacturer for installation with treads.

E. Locations: Provide resilient stair accessories in areas indicated and all risers, treads, and intermediate landings.

F. Colors and Patterns: Provide full range of manufacturer’s available color with square embossed pattern.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturers for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less except that adhesives for rubber stair treads shall have a VOC content of 60 g/L or less.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are at the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

## 3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths if practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

## 3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

## 3.5 INSTALLATION OF RESILIENT STAIR ACCESSORIES

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

## 3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Project Acceptance.

**END OF SECTION 096513**

## SECTION 096519 - RESILIENT TILE FLOORING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Luxury vinyl floor tile.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples: Full-size units of each color, texture, and pattern of floor tile required.

D. Samples for Initial Selection: For each type of floor tile indicated.

E. Samples for Verification: Full-size units of each color and pattern of floor tile required.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

### 1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by the manufacturer for floor tile installation and seaming method indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by the manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F, in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Project Acceptance, maintain ambient temperatures within range recommended by the manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 LUXURY VINYL FLOOR TILE (LV1)

A. Basis of Design: Interface, “Textured Stones,” or provide a comparable product by one of the following:

1. Interface (Basis of Design)
2. Bentley Mills
3. Patcraft

B. Tile Standard: ASTM F1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: B, Embossed Surface.

C. Size: 20 inches by 20 inches.

D. Colors and Patterns: As indicated by the Architect, selecting from the full range of styles, patterns, and product sizes available within the collection.

E. Installation: As indicated by the Architect, selecting from the full range of installation methods recommended within the collection.

2.3 LUXURY VINYL FLOOR TILE (LV2)

A. Basis of Design: Interface, “Raw Materials,” or provide a comparable product by one of the following:

1. Interface (Basis of Design)
2. Bentley Mills
3. Patcraft

B. Tile Standard: ASTM F1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: B, Embossed Surface.

C. Size: 5 inches by 40 inches.

D. Colors and Patterns: As indicated by the Architect, selecting from the full range of styles, patterns, and product sizes available within the collection.

E. Installation: As indicated by the Architect, selecting from the full range of installation methods recommended within the collection.

2.4 LUXURY VINYL FLOOR TILE (LV3)

A. Basis of Design: Interface, “Cut & Form,” or provide a comparable product by one of the following:

1. Interface (Basis of Design)
2. Bentley Mills
3. Patcraft

B. Tile Standard: ASTM F1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: B, Embossed Surface.

C. Size: 20 inches by 20 inches).

D. Colors and Patterns: As indicated by the Architect, selecting from the full range of styles, patterns, and product sizes available within the collection.

E. Installation: As indicated by the Architect, selecting from the full range of installation methods recommended within the collection.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following for VOC content: Vinyl Composition Tile Adhesives: 50 g/L or less.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
1. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer’s written recommendations, but not less stringent than the following:

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

## 3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

## 3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

**END OF SECTION 096519**

**SECTION 096813 - TILE CARPETING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes modular carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Carpet tile type, color, and dye lot.
2. Type, color, and location of edge, transition, and other accessory strips.

C. Product Schedule: For carpet tile. Use the same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by the carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Delamination.

3. Warranty Period: 10 years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 CARPET TILE (CR-1)

A. Basis of Design: Interface, “Mirrored Heights” collection | “Reflective Sky,” or provide a comparable product by one of the following:

1. Interface (Basis of Design)
2. Bentley Mills
3. Patcraft

B. Colors and Patterns: As indicated by the Architect, selecting from the full range of styles, patterns, and product sizes available within the entire collection.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Size: 9.845 inches by 39.38 inches.

E. Installation: As indicated by the Architect, selecting from the full range of installation methods recommended within the collection.

2.2 CARPET TILE (CR-2)

A. Basis of Design: Interface, “Twist & Texture” collection | “Knitstitch,” or provide a comparable product by one of the following:

1. Interface (Basis of Design)
2. Bentley Mills
3. Patcraft

B. Colors and Patterns: As indicated by the Architect, selecting from the full range of styles, patterns, and product sizes available within the entire collection.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Size: 20 inches by 20 inches.

E. Installation: As indicated by the Architect, selecting from the full range of installation methods recommended within the collection.

2.3 CARPET TILE (CR-3)

A. Basis of Design: Interface, “Twist & Texture” collection | “Knitstitch,” or provide a comparable product by one of the following:

1. Interface (Basis of Design)
2. Bentley Mills
3. Patcraft

B. Colors and Patterns: As indicated by the Architect, selecting from the full range of styles, patterns, and product sizes available within the entire collection.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Size: 20 inches by 20 inches.

E. Installation: As indicated by the Architect, selecting from the full range of installation methods recommended within the collection.

2.4 CARPET TILE (CR-4)

A. Basis of Design: Interface, “Twist & Texture” collection | “In the Fold,” or provide a comparable product by one of the following:

1. Interface (Basis of Design)
2. Bentley Mills
3. Patcraft

B. Colors and Patterns: As indicated by the Architect, selecting from the full range of styles, patterns, and product sizes available within the entire collection.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Size: 9.845 inches by 39.38 inches.

E. Installation: As indicated by the Architect, selecting from the full range of installation methods recommended within the collection.

2.5 CARPET TILE (CR-5)

A. Basis of Design: Interface, “Twist & Texture” collection | “Knitstitch,” or provide a comparable product by one of the following:

1. Interface (Basis of Design)
2. Bentley Mills
3. Patcraft

B. Colors and Patterns: As indicated by the Architect, selecting from the full range of styles, patterns, and product sizes available within the entire collection.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Size: 20 inches by 20 inches.

E. Installation: As indicated by the Architect, selecting from the full range of installation methods recommended within the collection.

2.6 Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturers.

2.7 Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturers for releasable installation.

1. VOC Limits: Provide adhesives with VOC content not more than 50- g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits. Verify that concrete slabs comply with the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
4. substances that may interfere with adhesive bond or show through surface.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

## 3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

H. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

## 3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

**END OF SECTION 096813**

## SECTION 099113 - EXTERIOR PAINTING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Steel.
2. Galvanized metal.

### 1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

### 1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish all extra unused paint, plus no less than 1 unopened gallon of each material and color applied.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. Duron, Inc.
3. ICI Paints.
4. Porter Paints.
5. PPG Architectural Finishes, Inc.
6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: For field applications, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

A. Exterior, Latex Wood Primer: White, waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbials; for hiding stains; and for use on exterior wood subject to extractive bleeding.

B. Quick-Drying, Alkyd Metal Primer: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, exterior steel surfaces.

2.4 FINISH COATINGS

A. Exterior Latex Paint, Gloss: Water-based, pigmented, acrylic-copolymer-emulsion coating formulated for alkali, mold, microbial, scrub, blocking (sticking of two painted surfaces), and water resistance and for use on exterior, primed, wood and metal trim, sashes, frames, and doors.

1. Gloss Level: Manufacturer's standard gloss finish.

B. Quick-Drying Alkyd Enamel, Gloss: Solvent-based, alkyd or modified-alkyd enamel formulated for quick-drying capabilities and for use on exterior, primed, metal and dimensionally stable wood surfaces.

1. Gloss Level: Manufacturer's standard gloss finish.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

## 3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

## 3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of paint materials with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

## 3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.6 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

1. Quick-Drying Enamel System:

a. Prime Coat: Quick-drying, alkyd metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Quick-drying alkyd enamel, gloss.

B. Exterior Gypsum Board Substrates:

1. Latex System:

a. Prime Coat: Exterior, latex wood primer, reduced in accordance with manufacturer's written instructions for substrate and topcoat.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint, gloss.

**END OF SECTION 099113**

## SECTION 099123 - INTERIOR PAINTING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.
3. Solvent-based finish coatings.
4. Floor sealers and paints.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: 10 percent, but not less than 1 full, unopened gallon of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Project Acceptance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Paints.
3. Sherwin-Williams Company (The).

B. Source Limitations: Obtain each paint product from single source from single manufacturer.

## 2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

1. Ten percent of surface area will be painted with deep tones.

2. Allow for multiple (up to two colors in all rooms).

## 2.3 PRIMERS

A. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

B. Water-Based Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, interior ferrous metals subject to mildly corrosive environments.

C. Water-Based Galvanized-Metal Primer: Corrosion-resistant, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.

## 2.4 WATER-BASED FINISH COATS

A. Interior, Latex, Institutional Low Odor/VOC, Semigloss: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.

1. Gloss Level: Manufacturer's standard semigloss finish.

2.5 FLOOR SEALERS AND PAINTS

A. Latex Floor Paint, Low Gloss: Water-based, pigmented coating formulated to hide stains, for alkali and incidental water resistance, and for use on concrete and primed-wood surfaces subject to low to medium foot traffic.

1. Gloss and Sheen Level: Manufacturer's standard low-gloss finish.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

## 3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Uninsulated metal piping.
b. Uninsulated plastic piping.
c. Pipe hangers and supports.
d. Metal conduit.
e. Plastic conduit.
f. Tanks that do not have factory-applied final finishes.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.

d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

## 3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.5 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Water-based rust-inhibitive primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss.

B. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Water-based galvanized primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss.

C. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss.

**END OF SECTION 099123**

## SECTION 099300 - STAINING AND TRANSPARENT FINISHING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Primers
2. Wood stains.
3. Transparent finishes.

### 1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

### 1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: Not less than 1 gal. unopened gallon of each material and color applied.

### 1.4 MOCKUPS

A. Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F above the dew point, or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. Coronado Paint; Benjamin Moore & Co.
3. PPG Paints; PPG Industries, Inc.
4. Sherwin-Williams Company (The).

2.2 SOURCE LIMITATIONS

A. Source Limitations: Obtain each coating product from single source from single manufacturer.

2.3 MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Stain Colors: As selected by Architect from manufacturer's full range.

2.4 PRIMERS

A. Primer, Alkyd Oil for Exterior Wood: Alkyd/oil-based primer for exterior wood with resistance to bleeding.

B. Alkyd Sanding Sealer, Interior, Solvent Based, Clear: Solvent-based, quick-drying, clear, sandable alkyd sealer used on new interior wood surfaces that are to be top-coated with an alkyd varnish.

2.5 WOOD STAINS

A. Stain, Exterior, Solvent Based, Semitransparent: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new wood surfaces.

B. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.

2.6 TRANSPARENT FINISHES

A. Varnish with UV Inhibitor, Exterior, Semigloss: Solvent-based, alkyd-type, clear semigloss varnish stabilized against UV deterioration for exterior wood surfaces.

1. Gloss Level: Manufacturer's standard semigloss finish.

B. Varnish, Exterior, Water Based, Semigloss: Water-based clear varnish for exterior wood surfaces.
1. Gloss Level: Manufacturer's standard semigloss finish.

C. Varnish, Interior, Water Based, Clear, Semigloss: Water-based clear semigloss coating for interior wood trim, frames, doors, paneling and cabinetry.
1. Gloss Level: Manufacturer's standard semigloss finish.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

## 3.2 PREPARATION

A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

C. Exterior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.

    a. For solid hide stained wood, stain edges and ends after priming.
    b. For varnish-coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.

3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

D. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

## 3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

## 3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

## 3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Exposed Framing:

1. Semitransparent Stain System:

    a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
    b. Topcoat: Stain, exterior, solvent based, semitransparent.

2. Varnish over Stain System:

    a. Stain Coat: Stain, exterior, solvent based, semitransparent.
    b. First Intermediate Coat: Varnish matching topcoat.
    c. Second Intermediate Coat: Varnish matching topcoat.
    d. Topcoat: Varnish, with UV inhibitor, exterior, semigloss.

## 3.6 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Wood Trim:

1. Semitransparent Stain System:

    a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
    b. Topcoat: Stain, exterior, solvent based, semitransparent.

2. Polyurethane Varnish over Stain System:

    a. Stain Coat: Stain, semitransparent, for interior wood.
    b. First Intermediate Coat: Polyurethane varnish matching topcoat.
    c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
    d. Topcoat: Varnish, interior, polyurethane, oil modified, semi-gloss.

B. Wood Substrates, Casework:

1. Semitransparent Stain System:

    a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
    b. Topcoat: Stain, exterior, solvent based, semitransparent.

2. Polyurethane Varnish over Stain System:

    a. Stain Coat: Stain, semitransparent, for interior wood.
    b. First Intermediate Coat: Polyurethane varnish matching topcoat.
    c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
    d. Topcoat: Varnish, interior, polyurethane, oil modified, semi-gloss.

**END OF SECTION 099300**

## SECTION 101100 - VISUAL DISPLAY UNITS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Glass markerboards.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

### 1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

### 2.2 GLASS MARKERBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A-1 Visual Systems.
2. Claridge Products and Equipment, Inc.
3. Clarus Glassboards, LLC.

B. Glass Markerboards: 6-mm tempered glass markerboard, with smooth polished edge and eased corners; color coated on back surface with steel backing for use with magnets.

C. Mounting: Concealed, Z-shaped brackets.

D. Color and Surface: Glossy in colors selected by the Architect from full-range of manufacturer’s colors.

E. Marker Tray: Magnetic.

F. Size: As noted on the Drawings.

G. Color: White.

### 2.3 MATERIALS

A. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

B. Extruded Aluminum: ASTM B 221, Alloy 6063.

### 2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display units. Add wood blocking for mounting as necessary.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

3.3 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints.
2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

3.4 CLEANING AND PROTECTION

A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

**END OF SECTION 101100**

**SECTION 101423 –PANEL SIGNAGE**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Panel signs.

1.3 DEFINITIONS

A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.".

B. ACCESSIBILITY STANDARD: ACCESSIBLE AND USABLE BUILDINGS AND FACILITIES. ICC A117.1-2009.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for signs.

1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.

C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:

1. Aluminum.
2. Acrylic sheet.
3. Polycarbonate sheet.
4. Fiberglass sheet.
5. Die-cut vinyl characters and graphic symbols. Include representative samples of available typestyles and graphic symbols.

D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:

1. Panel Signs: Not less than 12 inches square including border.

E. Sign Schedule: Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

B. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when[ existing and forecasted] weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate placement of anchorage devices with templates for installing signs.

**PART 2 - PRODUCTS**

2.1 MATERIALS

A. Fiberglass Sheet: Molded, seamless, thermosetting, glass-fiber-reinforced polyester panels with a minimum tensile strength of 15,000 psi when tested according to ASTM D 638 and with a minimum flexural strength of 30,000 psi when tested according to ASTM D 790.

B. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

C. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:

1. Impact Resistance: 16 ft-lbf/in. per ASTM D 256, Method A.
2. Tensile Strength: 9000 lbf/sq. in. per ASTM D 638.
3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D 790.
4. Heat Deflection: 265 deg F at 264 lbf/sq. in. per ASTM D 648.
5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.

D. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing, suitable for exterior applications.

2.2 PANEL SIGNS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ACE Sign Systems, Inc.
2. Advance Corporation; Braille-Tac Division.
3. APCO Graphics, Inc.
4. ASI-Modulex, Inc.
5. Best Sign Systems Inc.
6. Gemini Incorporated.
7. Mohawk Sign Systems.
8. Avali's Wayfinding Solutions, Inc,

B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:

1. Melamine Plastic Laminate, All signs 0.25 inch thick.
2. Edge Condition: Square cut.
3. Corner Condition: Square.
4. Mounting: Unframed.
    a. Wall mounted with two-face tape.
    b. Manufacturer's standard anchors for substrates encountered.
5. Color: As selected by Architect from manufacturer's full range.
6. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.

C. Exterior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:

1. Melamine Plastic Laminate, 0.250-inch thick.
2. Edge Condition: Square cut.
3. Corner Condition: Square.
4. Mounting: Unframed.
    a. Wall mounted.
    b. Manufacturer's standard noncorroding anchors for substrates encountered.
5. Color: As selected by Architect from manufacturer's full range.

D. Panel Sign Schedule (Mohawk Sign Systems, Inc. –Basis for Design). See Drawing A8.1 for special shape and color requirements:

1. PS #1: Room Identification Sign with Braille.
    a. Sign Size: 6"x6"x ¼".
    b. Message Panel Material: Interior Panel Sign, Series 300.
    c. Text/Message: Room #.
    d. Location: As directed in the field by Architect.
    e. Quantity: Provide one per interior non-occupied room such as Mechanical, Data, Electrical Rooms. Provide sign with STAIR including graphic at each stair door.
2. PS #2: Room Identification Sign with Braille and Two Changeable Message Insert.
    a. Sign Size: 6"x6"x ¼".

b. Message Panel Material: Interior Panel Sign, Series 300 w/two changeable message inserts.
c. Text/Message: Room #.
d. Location: As directed in the field by Architect.
e. Quantity: Provide one per occupied room except two if there are two doors.

3. PS #3: Room Identification Sign with pictograms and Braille.

a. Sign Size: 6”x8”x ¼”.
b. Message Panel Material: Interior Panel Sign, Series 300 w/male or female pictogram and accessibility symbol.
c. Text/Message: Male or Female.
d. Location: As directed in the field by Architect.
e. Quantity: one per toilet room, gender as indicated by room name.

4. PS #5: Room Identification Sign with Braille- Exterior:

a. Sign Size: 6”x6”x ¼”.
b. Message Panel Material: Exterior Panel Sign, Series 300.
c. Text/Message: Room #.
d. Location: As directed in the field by Architect.
e. Quantity: Provide one at each exterior mechanical or electrical room exterior door.

## 2.3 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

## 2.4 FABRICATION

A. General: Provide manufacturer's standard signs of configurations indicated.

1. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

## 2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ACRYLIC SHEET FINISHES

A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for three years for application intended.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items, including anchor inserts, are sized and located to accommodate signs.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.

1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
2. Hook-and-Loop Tapes: Mount signs to smooth, nonporous surfaces.
3. Magnetic Tape: Mount signs to smooth, nonporous surfaces.
4. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
5. Shim Plate Mounting: Provide 1/8-inch-thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
6. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
7. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

**END OF SECTION 101400**

## SECTION 102113 - TOILET COMPARTMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Solid-polymer toilet compartments configured as toilet enclosures.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.
3. Show locations of centerlines of toilet fixtures.

C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

### 1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

**PART 2 - PRODUCTS**

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

B. Stainless-Steel Castings: ASTM A 743/A 743M.

2.2 SOLID-POLYMER UNITS

A. Basis of Design: Toilet partitions as manufactured by and supplied by Scranton Products, specifically Hiny Hiders, Grip EX – Stainless (metallic series), or, provide a comparable product by one of the following:

1. Scranton Products, Hiny Hiders Grip EX Texture.
2. Global Partition Systems; ASI Group (Tough Texture TT).
3. Accurate Partitions Corporation; ASI Group (Tough Texture TT).

B. Toilet-Enclosure Style: Overhead braced.

C. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) or polypropylene (PP) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range. Provide surface texture pattern similar to Hiny Hiders Santana-Comtec “Grip EX” Collection.

D. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

E. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.
2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 36-inch-wide, clear opening for compartments designated as accessible.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang

doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

**END OF SECTION 102113**

## SECTION 102239 - FOLDING PANEL PARTITIONS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Electrically operated, acoustical panel partitions.

### 1.3 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. STC: Sound Transmission Class.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For operable panel partitions.

1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
3. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:

1. Textile Facing Material: Full width by not less than 36-inch-long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
3. Panel Edge Material: Not less than 3 inches long.
4. Hardware: One of each exposed door-operating device.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
b. Seals, hardware, track, track switches, carriers, and other operating components.
c. Electric operator and controls.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."

B. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.

2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.
3. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.

C. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kwik-Wall . (Model 3050, Basis of Design)
b. Modernfold, Inc.
c. Moderco Inc.

B. Panel Operation: Electrically operated, continuously hinged panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: Standard widths.

E. STC: Not less than 52.

F. Panel Weight: 12 lb/sq. ft. maximum.

G. Panel Thickness: Not less than 4 inches.

H. Panel Materials:

1. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
2. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.

I. Panel Closure: Manufacturer's standard unless otherwise indicated.

1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.

J. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

1. Hinges: Concealed (invisible).

## 2.3 SEALS

A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:

1. Seals made from materials and in profiles that minimize sound leakage.
2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous PVC acoustical seal.

C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track or PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.

D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.

1. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 1 inch between retracted seal and floor finish.

## 2.4 PANEL FINISH FACINGS

A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.

1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
3. Match facing pattern 72 inches above finished floor.

B. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.

1. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
2. Color/Pattern: As selected by Architect from manufacturer's full range.

C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:

1. Steel, Painted: Finished with manufacturer's color as selected by Architect from manufacturer's full range.
2. Aluminum: Finished with manufacturer's standard **clear anodic** finish.

## 2.5 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

1. Multidirectional Carriers: Capable of negotiating intersections without track switches.

C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.
2. L Intersections: Allow panels to change 90 degrees in direction of travel.
3. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.
4. X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.
5. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.
6. Center carrier stop.

D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.6 ELECTRIC OPERATORS

A. General: Factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

B. Comply with NFPA 70.

C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

D. Motor Electrical Characteristics:

1. Horsepower: Manufacturer's standard.
2. Volts: 120.
3. Phase: Coordinate with building’s electrical system indicated.
4. Hertz: 60.

E. Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and " Stop." Furnish two keys per station.

F. Obstruction-Detection Devices: Equip each motorized operable panel partition with indicated automatic safety sensor that causes operator to immediately stop and reverse direction.

1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.

G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.

H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

I. Electric Interlock: Equip each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:

1. On storage pocket door, to prevent operation if door is not in fully open position.
2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

## 3.3 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

## 3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

**END OF SECTION 102239**

## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Private-use bathroom accessories.
4. Warm-air dryers.
5. Underlavatory guards.
6. Custodial accessories.

### 1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Samples: Full size, for each exposed product and for each finish specified.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PUBLIC-USE/PRIVATE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Waste Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AJW Architectural Products.
    b. American Specialties, Inc.
    c. Bobrick Washroom Equipment, Inc.
    d. Bradley Corporation.

2. Description: Unit with removable waste receptacle.
3. Mounting: Semirecessed.

    a. Designed for nominal 6-inch wall depth.
4. Minimum Waste-Receptacle Capacity: 12 gal..
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Liner: Reusable, vinyl waste-receptacle liner.
7. Lockset: Tumbler type for waste receptacle.

C. Grab Bar:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AJW Architectural Products.
    b. American Specialties, Inc.
    c. Bobrick Washroom Equipment, Inc.
    d. Bradley Corporation.

2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.

a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: As indicated on Drawings.

D. Mirror Unit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AJW Architectural Products.
b. American Specialties, Inc.
c. Bobrick Washroom Equipment, Inc.
d. Bradley Corporation.

2. Frame: Stainless-steel angle, 0.05 inch thick.

a. Corners: Welded and ground smooth.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: As indicated on Drawings.

## 2.3 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Buckaroos, Inc.
b. Plumberex Specialty Products, Inc.
c. Truebro by IPS Corporation.

2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

## 2.4 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Mop and Broom Holder:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AJW Architectural Products.

b. American Specialties, Inc.
c. Bobrick Washroom Equipment, Inc.
d. Bradley Corporation.

2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
b. Rod: Approximately 1/4-inch-diameter stainless steel.

2.5 MATERIALS

A. Stainless Steel: ASTM A666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

C. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

**END OF SECTION 102800**

## SECTION 104413 - FIRE PROTECTION CABINETS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguishers.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semi-recessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

1. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

### 1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire-End & Croker Corporation.
b. JL Industries, Inc.; a division of the Activar Construction Products Group.
c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc
d. Larsens Manufacturing Company.

B. Cabinet Construction: Nonrated] 1-hour fire rated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Stainless-steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Stainless-steel sheet.

F. Door Material: Stainless-steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Silk-screened.
3) Lettering Color: Red.
4) Orientation: Vertical.

K. Materials:

1. Stainless Steel: ASTM A 666, Type 304.
2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

## 2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

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.

## 2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated

1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 104413**

## SECTION 104416 - FIRE EXTINGUISHERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

### 1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

## PART 2 - PRODUCTS

### 2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Fire End & Croker Corporation
    b. J. L. Industries, Inc., a division of Activar Construction Products Group
    c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc
    d. Larsen's Manufacturing Company

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A:40-B:C, 6-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

**END OF SECTION 104416**

**SECTION: 105300- ALUMINUM CANOPY**

**PART 1 - GENERAL**

1.1 DESCRIPTION OF WORK

A. Work in this section includes furnishing and installation of roll-formed aluminum cantilevered style canopies.

B. Related Items and Considerations

1. Flashing of various designs may be required. Generic flashing. Specialty flashing to be supplied by installer.

2. Determine wall construction, make-up and thickness.

3. Ensure adequate wall condition to carry canopy loads where required.

4. Consider water drainage away from canopy where necessary.

5. Any necessary removal or relocation of existing structures, obstructions or materials.

1.2 FIELD MEASUREMENT

A. Confirm dimensions prior to preparation of shop drawings when possible.

B. If requested, supply manufacturer s standard literature and specifications for canopies.

C. Submit shop drawings showing structural component locations/positions, material dimensions and details of construction and assembly, signed and sealed by a North Carolina professional engineer.

1.3 PERFORMANCE REQUIREMENTS

A. Canopy must conform to local building codes.

1.4 DELIVER, STORAGE, HANDLING

A. Deliver and store all canopy components in protected areas.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Mapes Super Lumideck, Hanger Rod Canopy** or a comparable product by one of the following:

1. Architectural Fabrication
2. MASA Architectural Canopies

3. Mitchell Metals
4. SkyScape Architectural Canopies

B. Basis-of-Design Product: Subject to compliance with requirements, provide Mapes Cantilever or a comparable product by one of the following:

1. Architectural Fabrication
2. MASA Architectural Canopies
3. Mitchell Metals
4. SkyScape Architectural Canopies

## 2.2 MATERIALS

A. Decking shall consist of an interlocking roll-form W style pan (.078" aluminum).

B. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in profile and thickness shown on Drawings.

C. Fascia shall be standard extruded 8" J style.

## 2.3 FINISHES

A. Finish type shall be -- Class II Clear Anodized.

## 2.4 FABRICATION

A. All canopies are shipped in preassembled sections for ease of installation.

1. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.

B. Decking shall be designed with interlocking roll-formed aluminum members.

C. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Front Scupper.

# PART 3 - EXECUTION

## 3.1 INSPECTION

A. Confirm that surrounding area is ready for the canopy installation.

B. Installer shall confirm dimensions and elevations to be as shown on drawings.

C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed

## 3.2 INSTALLATION

A. Installation shall be in strict accordance with manufacturer s shop drawings. Particular attention should be given to protecting the finish during handling and erection.

3.3 After installation, entire system shall be left in a clean condition.

**END OF SECTION 105300**

## SECTION 107516 - GROUND-SET FLAGPOLES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes ground-set flagpoles made from aluminum.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For flagpoles.

1. Include plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
2. Include section, and details of foundation system.

C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.

D. Delegated-Design Submittal: For flagpoles.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.

B. Seismic Performance: Flagpole assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is shown on the Contract Documents.
2. Base flagpole design on nylon or cotton flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

## 2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acme/Lingo Flagpoles, LLC.
b. American Flagpole.
c. Concord Industries, Inc.
d. Ewing Flagpoles.
e. U.S. Flag & Flagpole Supply, LP.

B. Exposed Height: One 35-foot pole and two 30-foot poles.

C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch wall thickness with 3/16-inch steel bottom plate and support plate; 3/4-inch-diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.

1. Flashing Collar: Same material and finish as flagpole.

E. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.

1. Flashing Collar: Same material and finish as flagpole.

## 2.4 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch spun aluminum with clear anodic finish.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Chromium-plated bronze swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.
2. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Furnish two per halyard.

2.5 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C 33/C 33M, fine aggregate.

D. Elastomeric Joint Sealant: Single-component nonsag urethane joint sealant complying with requirements in Section 079200 "Joint Sealants."

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

**PART 3 - EXECUTION**

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

E. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.

F. Anchor Bolts: Locate and secure anchor bolts in forms with templates and by tying to reinforcement.

G. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

H. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

## 3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

**END OF SECTION 107516**

## SECTION 122413 - ROLLER WINDOW SHADES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Manually operated, single-roller shades.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of roller shade.
1. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
2. Installation Accessories: Full-size unit, not less than 10 inches long.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

### 1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Defects in materials and workmanship beyond normal wear and tear.
b. Faulty operation of operating system components.
c. Deterioration of fabric beyond normal use.

2. Warranty Period:

a. Roller Window Shades: Five year(s) from date of Project Acceptance.
b. Fabric: Five year(s) from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 2.3 MANUALLY OPERATED, SINGLE-ROLLER SHADES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Draper, Inc.
2. Hunter Douglas, Inc.
3. Lutron Electronics Co., Inc.
4. MechoShade Systems, LLC.

B. Manually Operated, Single-Roller Shades: For interior use in rectangular openings. Provide roller shade to cover each W1, W2, W3, and W4 Window types on the project.

1. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

    a. Roller Drive-End Location: Right side of interior face of shade or Left side of interior face of shade.
    b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
    c. Shadeband-to-Roller Attachment: Manufacturer's standard method.

2. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to six inline rollers into a multiband shade that is operated by one roller drive-end assembly.
3. Shadebands:

    a. Shadeband Material: Light-filtering fabric.
    b. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

        1) Type: Elliptical slat enclosed in sealed pocket of shadeband material.
        2) Color and Finish: As selected by Architect from manufacturer's full range.

4. Mounting Hardware: Brackets or endcaps, with endcap covers where exposed, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and installation location and conditions indicated.
5. Installation Accessories:

    a. Front Fascia: Aluminum extrusion that conceals front and underside of roller and shadeband assembly and attaches to roller endcaps without exposed fasteners.

        1) Shape: L-shaped.
        2) Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches (102 mm).

## 2.3 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

2.4 MANUAL OPERATION

A. Manual Cordless Operation:

1. Crank-and-Gear Operating Mechanisms: Sealed gearbox drive system controlled by crank handle.

a. Crank-Handle Type: Permanently mounted.
b. Crank-Handle Length: Manufacturer's standard.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Project Acceptance.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Project Acceptance.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain manually-operated roller shades.

**END OF SECTION 122413**

## SECTION 123661 - SIMULATED STONE COUNTERTOPS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Solid-surface-material countertops and backsplashes.

### 1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

### 1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

### 1.5 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

## PART 2 - PRODUCTS

### 2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS (CTOP-1)

A. Basis of Design for large restrooms, single-user restrooms, break rooms, and work rooms: Durasein Solid Surface. Or provide a comparable product by one of the following:

1. Durasein Solid Surface

2. Corian
3. Wilsonart

2.2 Configuration: Provide countertops with the following front and backsplash style:

A. Front: 3/4-inch bullnose. Waterfall Edge.
B. Backsplash: Radius edge with 3/8-inch radius.
C. Endsplash: Matching backsplash.

2.3 Countertops: 1/2-inch-thick, solid surface material with front edge built up with same material.

2.4 Backsplashes: 1/2-inch-thick, solid surface material.

2.5 Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

A. Fabricate with loose backsplashes for field assembly.

2.6 COUNTERTOP MATERIALS

A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

B. Adhesives: Adhesives shall not contain urea formaldehyde.

C. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.

1. Type: Provide Standard Type unless Special Purpose Type is indicated.
2. Colors and Patterns: As selected by Architect from manufacturer's full range.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

**END OF SECTION 123661**

## SECTION 124816 - ENTRANCE FLOOR GRILLES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes recessed floor grilles and frames.

### 1.3 COORDINATION

A. Coordinate size and location of recesses in concrete to receive floor grilles and frames.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for entrance floor grilles and frames.

B. Shop Drawings:

1. Items penetrating floor grilles and frames, including door control devices.
2. Divisions between grille sections.
3. Perimeter floor moldings.

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Grille: Assembled section of floor grille.
2. Frame Members: Sample of each type and color.

### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor grilles and frames to include in maintenance manuals.

### 1.6 FIELD CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babcock-Davis.
2. Balco, Inc.
3. C/S Group (Basis for Design, Pedigrid G1).
4. JL Industries, Inc.; a division of the Activar Construction Products Group.
5. Kadee Industries, Inc.

### 2.2 ENTRANCE FLOOR GRILLES, GENERAL

A. Structural Performance: Provide floor grilles and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

1. Uniform floor load of 300 lbf/sq. ft..
2. Wheel load of 350 lb per wheel.

B. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

### 2.3 FLOOR GRILLES

A. General: Provide manufacturer's standard floor-grille assemblies consisting of treads of type and profile indicated, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.

B. Aluminum Floor Grilles: Provide manufacturer's standard floor grilles with extruded members, top-surfaced tread rails, and as follows:

1. Tread Rails: Extruded-aluminum tread rails.

a. Aluminum Color: Clear.

2. Tread Rail Spacing: 1-1/2 inches o.c. with 1/8- to 3/16-inch-wide openings between treads.
3. Top Surface: Serrated vinyl cap with UV stabilizer and antifungal additive.

a. Top Surface Color: Match tread rail.

4. Grille Size: As indicated.

C. Lockdown: Manufacturer's standard.

### 2.4 FRAMES

A. Provide manufacturer's standard frames of size and style for grille type, for permanent recessed installation in subfloor, complete with installation anchorages and accessories. Unless otherwise indicated, fabricate frame of same material and finish as grilles.

2.5 SUPPORT SYSTEM

A. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.

B. Drainage Pit Applications: Provide manufacturer's special deep-pit frame and support extrusion system with intermediate support beams, sized and spaced as recommended by manufacturer for indicated spans and equipped with vinyl support cushions.

2.6 MATERIALS

A. Aluminum Sheet: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15.

B. Extruded Aluminum: ASTM B221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52 as standard with manufacturer.

2.7 FABRICATION

A. Shop fabricate floor grilles to greatest extent possible in sizes as indicated. Unless otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.

B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

C. Coat surface of aluminum in contact with cementitious materials with manufacturer's standard protective coating.

2.8 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, size, minimum recess depth, and other conditions affecting installation of floor grilles and frames.

B. Examine roughing-in for drainage piping systems to verify actual locations of piping connections before floor grille and frame and drain pan installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed floor grilles and frames to comply with manufacturer's written instructions at locations indicated and with top of floor grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set floor-grille tops at height for most effective cleaning action. Coordinate top of floor-grille surfaces with doors that swing across grilles to provide clearance under door.

3.3 PROTECTION

A. After completing frame installations, provide temporary filler of plywood or fiberboard in floor-grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Project Acceptance.

**END OF SECTION 124816**

## SECTION 142400 - HYDRAULIC ELEVATORS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Hydraulic elevators with Machine Room.

### 1.2 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing; machine room layout; coordination with building structure; relationships with other construction; and locations of equipment.
2. Include large-scale layout of car-control station and standby-power operation control panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes, 3-inch-square Samples of sheet materials and 4-inch lengths of running trim members.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine room layout and dimensions, as indicated on Drawings, and electrical service, as indicated and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

## 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. Submit manufacturer's/installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

## 1.8 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Furnish well casing and coordinate delivery with related excavation work.

C. Coordinate locations and dimensions of other work specified in other Sections that relates to hydraulic elevators, including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

## 1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

2. Warranty Period: 5 year(s) from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 HYDRAULIC ELEVATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Otis Worldwide Corporation (Basis of Design, HydroFit with Machine Room, 4500# 150 FPM, Hospital)
2. Schindler Elevator Corp.
3. Schumacher Elevator Co.
4. ThyssenKrupp Elevator.

B. Source Limitations: Obtain elevators, including freight and electric traction passenger elevators specified in other Sections, from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, are manufactured by single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Standard: Comply with applicable provisions in ICC A117.1 and the NC Building Code 2018.

C. Seismic Performance: Elevator system withstands the effects of earthquake motions determined according to ASCE/SEI 7 and complies with elevator seismic requirements in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Project Seismic Design Category: C.
3. Elevator Component Importance Factor: 1.5.
4. Design earthquake spectral response acceleration short period (Sds) for Project is as noted.
5. Provide earthquake equipment required by ASME A17.1/CSA B44.
6. Provide seismic switch required by ASCE/SEI 7.

### 2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components are used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Group Number: 1.
2. Elevator Number(s): 1.
3. Type:

a. Holeless, beside-the-car, single-acting, dual cylinder.

4. Rated Load: 4500 lb.
5. Freight Loading Class for Service Elevators: Class A.
6. Rated Speed: 125 fpm.
7. Operation System: Single automatic operation.
8. Auxiliary Operations:

    a. Battery-powered lowering.
    b. Off-peak operation
    c. Automatic operation of lights and ventilation fans.

9. Security Features: Card-reader operation and Car-to-lobby feature.
10. Dual Car-Control Stations: Provide two car-control stations in each elevator; equip only one with required keyswitches if any.

11. Car Enclosures:

    a. Inside Width: 65 9/16 inches from side wall to side wall.
    b. Inside Depth: 115 inches from back wall to front wall (return panels).
    c. Inside Height: Not less than 93 inches to underside of ceiling.
    d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish with integral car door frames.
    e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    f. Side and Rear Wall Panels: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    g. Reveals: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    h. Door Faces (Interior): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    i. Door Sills: Aluminum.
    j. Ceiling: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    k. Handrails: 1/2 by 2 inches rectangular satin stainless steel, at sides and rear of car.
    l. Floor prepared to receive resilient flooring per Building Finish Schedule.

12. Hoistway Entrances:

    a. Width: 48 inches.
    b. Height: 84 inches.
    c. Type: Two-speed center opening.
    d. Frames: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    e. Doors and Transoms: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    f. Sills: Aluminum.

13. Hall Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
14. Additional Requirements:

    a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/A480M, No. 4 finish.
    b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

## 2.4 SYSTEMS AND COMPONENTS

A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.

1. Pump is submersible type with submersible squirrel-cage induction motor, and suspended inside oil tank from vibration isolation mounts or is tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and is mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch-thick, glass-fiber insulation board.
2. Motor has wye-delta or solid-state starting.
3. Motor has variable-voltage, variable-frequency control.

B. Hydraulic Silencers: System has hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.

C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.

D. Hydraulic Fluid:

1. Hydraulic Fluid, Manufacturer's Standard: Elevator manufacturer's standard fire-resistant fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

F. Car Frame and Platform: Welded or bolted steel units.

G. Guides: Roller guides, Polymer-coated, nonlubricated sliding guides or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car frame.

## 2.5 OPERATION SYSTEMS

A. Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.

B. Auxiliary Operations:

1. Group Standby-Power Operation:

a. On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car is moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.

2. Group Standby-Powered Lowering:

a. On activation of standby power, cars are lowered to the lowest floor, open their doors, and shut down.

3. Group Battery-Powered Lowering:

a. If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
b. When power fails, cars are lowered to the lowest floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.

4. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
5. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls can be adjusted.
6. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
7. Off-Peak Operation: During periods of low traffic, half of the elevators in a group are taken out of service and switched to low-power mode.
8. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
9. Priority Service: Service is initiated by a card reader at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks, and a lighted sign directs passengers to exit elevator. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car returns to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.
10. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.

C. Security Features: Security features do not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at car-control stations and hall push-button stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space for card reader in car.

a. Security access system equipment is not in the Contract and provided by the Owner.

2. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations and hall push-button stations. Key is removable only in deactivated position.
3. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.

a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.

4. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes all cars in a group to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

## 2.6 DOOR-REOPENING DEVICES

A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer sounds and doors begin to close at reduced kinetic energy.

## 2.7 CAR ENCLOSURES

A. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor:

    a. Exterior, underlayment-grade plywood, not less than 5/8-inch nominal thickness.
    b. Exterior, C-C Plugged grade plywood, not less than 7/8-inch nominal thickness.

2. Floor Finish:

    a. Specified in Finish Schedule "."
3. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
9. Ceiling: Metal flush panels, with four low-voltage downlights in each panel. Align ceiling panel joints with joints between wall panels.
10. Light Fixture Efficiency: Not less than 35 lumens/W.
11. Ventilation Fan Efficiency: Not less than 3.0 cfm/W.

## 2.8 HOISTWAY ENTRANCES

A. Fire-Rated Hoistway Entrance Assemblies: Door-and-frame assemblies comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252.

1. Fire-Protection Rating: 1 hour.

B. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Stainless Steel Frames: Formed from stainless steel sheet.
2. Stainless Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless steel sheet.
3. Sight Guards: Provide sight guards on doors matching door edges.
4. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 284600 "Fire Detection and Alarm."

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing.

1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Section 284600 "Fire Detection and Alarm."

G. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide the following:

1. Units mounted in both jambs of entrance frame.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor.

1. Provide units with flat faceplate for mounting and with body of unit recessed in wall integral with entrance head jamb.
2. Integrate ground-floor hall lanterns with hall position indicators.

J. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby-power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

K. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of

service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

D. Stainless Steel Bars: ASTM A276/A276M, Type 304.

E. Stainless Steel Tubing: ASTM A554, Grade MT 304.

F. Aluminum Extrusions: ASTM B221, Alloy 6063.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HYDRAULIC ELEVATORS

A. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

B. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

C. Lubricate operating parts of systems as recommended by manufacturers.

D. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

E. Leveling Tolerance: 1/4 inch, up or down, regardless of load and travel direction.

F. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

G. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of 72 inches above finished floor.

## 3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

## 3.4 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes. Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

## 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

## 3.6 MAINTENANCE

A. Initial Maintenance Service: Beginning at Project Acceptance, maintenance service includes 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies are manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of two hours or less.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

**END OF SECTION 142400**

## SECTION 313116 - TERMITE CONTROL

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Soil treatment with termiticide.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of termite control product.

1. Include the EPA-Registered Label for termiticide products.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For termite control products, from manufacturer.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products.

B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

C. Source Limitations: Obtain termite control products from single source from single manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.7 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Project Acceptance.

**PART 2 - PRODUCTS**

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation, Agricultural Products; Termidor.
b. Bayer Environmental Science; Premise 75.
c. FMC Corporation, Agricultural Products Group; Dragnet FT, Talstar, Prevail.
d. Syngenta; Demon TC, Prelude, Probuild TC.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

**END OF SECTION 313116**

**SECTION 321413-INTERLOCKING CONCRETE UNIT PAVING**

## PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Concrete paver units.
2. Bedding and joint sand.
3. Edge restraints.

1.02 REFERENCES

A. American Society of Testing and Materials (ASTM):

1. C 33, Specification for Concrete Aggregates.
2. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
4. C 144, Standard Specification for Aggregate for Masonry Mortar.
5. C 936, Specification for Solid Interlocking Concrete Paving Units.
6. C 979, Standard Specification for Pigments for Integrally Colored Concrete.
7. C 1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.

B. Interlocking Concrete Pavement Institute (ICPI)

1. ICPI Tech Spec Technical Bulletins

1.03 SUBMITTALS

A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Manufacturer’s drawings and details: Indicate perimeter conditions, relationship to adjoining materials and assemblies, expansion and control joints, concrete paver layout, patterns, color arrangement, installation and setting details.

C. Sieve analysis per ASTM C 136 for grading of bedding and joint sand.

E. Concrete pavers:

1. Four representative full-size samples of each paver type, thickness, color, finish that indicate the range of color variation and texture expected in the finished installation. Color(s) selected by Architect from manufacturer’s available colors.
2. Accepted samples become the standard of acceptance for the work.
3. Test results from an independent testing laboratory for compliance of paving unit requirements to ASTM C 936.
4. Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.

F. Paver Installation Subcontractor:

1. A copy of Subcontractor's current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
2. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

1.04 QUALITY ASSURANCE

A. Paving Subcontractor Qualifications:

1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
2. Utilize an installer holding a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.

B. Regulatory Requirements and Approvals: [Specify applicable licensing, bonding or other requirements of regulatory agencies.].

C. Mock-Ups:

1. Install a 7 ft x 7 ft (2 x 2 m) paver area.
2. Use this area to determine surcharge of the bedding sand layer, joint sizes, lines, laying pattern(s), color(s), and texture of the job.
3. This area will be used as the standard by which the work will be judged.
4. Subject to acceptance by owner, mock-up may be retained as part of finished work.
5. If mock-up is not retained, remove and properly dispose of mock-up.

1.05 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers packaging with identification labels intact.

1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.

2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by fork lift or clamp lift.

3. Unload pavers at job site in such a manner that no damage occurs to the product.

D. Storage and Protection: Store materials protected such that they are kept free from mud, dirt, and other foreign materials. [Store concrete paver cleaners and sealers per manufacturer's instructions.]

1. Cover bedding sand and joint sand with waterproof covering if needed to prevent exposure to rainfall or removal by wind. Secure the covering in place.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Do not install sand or pavers during heavy rain or snowfall.

2. Do not install sand and pavers over frozen aggregate base materials.
3. Do not install frozen sand or saturated sand.
4. Do not install concrete pavers on frozen or saturated sand.

1.07 MAINTENANCE

A. Extra Materials: Provide 4% additional material for use by owner for maintenance and repair.

B. Pavers shall be from the same production run as installed materials.

**PART 2 PRODUCTS**

2.01 CONCRETE PAVERS

A. Manufacturer: Keystone Hardscapes, 800-747-8971 or equal by Techo-Bloc or Nicolock.

B. Interlocking Concrete Pavers:

1. Paver Type: [Specify name of product group, family, series, etc.].

a. Material Standard: Comply with material standards in ASTM C 936.
d. Size: 4 x 8, 8 x 8, 8 x 12, by 2" thick.
e. Average Compressive Strength (ASTM C 140): 8000 psi (55 MPa) with no individual unit under 7200 psi (50 MPa) per ASTM C 140.
f. Average Water Absorption (ASTM C 140): 5% with no unit greater than 7%.
g. Freeze/Thaw Resistance (ASTM C 1645): Provide test results to 28 freeze/thaw cycles with no greater loss than 225 $g/m^2$ of surface area or 49 cycles with no greater loss than 500 $g/m^2$ of surface area. Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions.

2.03 BEDDING AND JOINT SAND

A. Provide bedding and joint sand as follows:

1. Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
2. Do not use limestone screenings, stone dust, or sand for the bedding sand material that do not conform to the grading requirements of ASTM C 33.
3. Do not use mason sand or sand conforming to ASTM C 144 for the bedding sand.
4. Where concrete pavers are subject to vehicular traffic, utilize sands that are as hard as practically available.
5. Sieve according to ASTM C 136.
6. Bedding Sand Material Requirements: Conform to the grading requirements of ASTM C 33 with modifications as shown in Table 1.

Table 1
ASTM C 33Grading Requirements for Bedding Sand

| Sieve Size | Percent Passing |
|---|---|
| 3/8 in. (9.5 mm) | 100 |
| No. 4 (4.75 mm) | 95 to 100 |
| No. 8 (2.36 mm) | 85 to 100 |
| No. 16 (1.18 mm) | 50 to 85 |
| No. 30 (0.600 mm) | 25 to 60 |

| | |
|---|---|
| No. 50 (0.300 mm) | 10 to 30 |
| No. 100 (0.150 mm) | 2 to 10 |
| No. 200 (0.075 mm) | 0 to 1 |

6. Joint Sand Material Requirements: Conform to the grading requirements of ASTM C 144 as shown with modifications in Table 2 below:

*Note: Due to the chamfer configuration on all the Verona products, C144 sand is recommended for jointing sand. C144 is not recommended for bedding sand.*

Table 2
ASTM C 144 Grading for Joint Sand

| | Natural Sand | Manufactured Sand |
|---|---|---|
| Sieve Size | Percent Passing | Percent Passing |
| No. 4 (4.75 mm) | 100 | 100 |
| No. 8 (2.36 mm) | 95 to 100 | 95 to 100 |
| No. 16 (1.18 mm) | 70 to 100 | 70 to 100 |
| No. 30 (0.600 mm) | 40 to 75 | 40 to 100 |
| No. 50 (0.300 mm) | 10 to 35 | 20 to 40 |
| No. 100 (0.150 mm) | 2 to 15 | 10 to 25 |
| No. 200 (0.075 mm) | 0 to 5 | 0 to 5 |

2.04 EDGE RESTRAINTS

A. Provide edge restraints installed around the perimeter of all interlocking concrete paving unit areas as follows:
   1. Manufacturer: Edge Right COR 10 Steel.
   2. Material: Core-10 Steel.

**PART 3 EXECUTION**

3.02 EXAMINATION

A. Acceptance of Site Verification of Conditions:
   1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.
      a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
      b. Verify that geotextiles, if applicable, have been placed according to drawings and specifications.
      c. Verify that Aggregate base materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
      d. Provide written density test results for soil subgrade, aggregate base materials to the Architect, Owner, General Contractor and paver installation subcontractor.
      e. Verify location, type, and elevations of edge restraints, utility structures, and drainage holes and inlets.
   2. Do not proceed with installation of bedding sand and interlocking concrete pavers until subgrade soil and base conditions are corrected by the General Contractor or designated subcontractor.

3.03 PREPARATION

A. Verify base is clean and dry, certified by General Contractor as meeting material, installation and grade specifications.

B. Verify that base is ready to support sand, edge restraints, and, pavers and imposed loads.

C. Edge Restraint Preparation:

1. Install edge restraints at paver transitions to grass or bed areas and flush with pavers.

3.04 INSTALLATION

A. Spread bedding sand evenly over the base course and screed to a nominal 1 in. (25 mm) thickness. Spread bedding sand evenly over the base course and screed rails, using the rails and/or edge restraints to produce a nominal 1 in. (25 mm) thickness, allowing for specified variation in the base surface.
   1. Do not disturb screeded sand.
   2. Screeded area shall not substantially exceed that which is covered by pavers in one day.
   3. Do not use bedding sand to fill depressions in the base surface.

B. Lay pavers in pattern(s) shown on drawings. Place units hand tight without using hammers. Make horizontal adjustments to placement of laid pavers with rubber hammers as required.

C. Provide joints between pavers between 1/16 in. and 3/16 in. wide. No more than 5% of the joints shall exceed 1/4 in. wide to achieve straight bond lines.

D. Joint (bond) lines shall not deviate more than ±1/2 in. over 50 ft. from string lines.

E. Fill gaps at the edges of the paved area with cut pavers or edge units.

F. Cut pavers to be placed along the edge with a masonry saw.

G. [Adjust bond pattern at pavement edges such that cutting of edge pavers is minimized.

H. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and joint sand.

I. Use a low-amplitude plate compactor capable of at least minimum of 4,000 lbf (18 kN) at a frequency of 75 to 100 Hz to vibrate the pavers into the sand. Remove any cracked or damaged pavers and replace with new units.

J. Simultaneously spread, sweep and compact dry joint sand into joints continuously until full. This will require at least 4 to 6 passes with a plate compactor. Do not compact within 6 ft (2 m) of unrestrained edges of paving units.

K. All work within 6 ft. (2 m) of the laying face must shall be left fully compacted with sand-filled joints at the end of each day or compacted upon acceptance of the work. Cover the laying face or any incomplete areas with plastic sheets overnight if not closed with cut and compacted pavers with joint sand to prevent exposed bedding sand from becoming saturated from rainfall.

L. Remove excess sand from surface when installation is complete.

M. Allow excess joint sand to remain on surface to protect pavers from damage from other trades. Remove excess sand when directed by [Architect].

N. Surface shall be broom clean after removal of excess joint sand.

3.05 FIELD QUALITY CONTROL

A. The final surface tolerance from grade elevations shall not deviate more than ±□3/8 in. (±10 mm) under a 10 ft (3 m) straightedge.

B. Check final surface elevations for conformance to drawings.

C. The surface elevation of pavers shall be 1/8 in. to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

D. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.

3.07 PROTECTION

A. After work in this section is complete, the General Contractor shall be responsible for protecting work from damage due to subsequent construction activity on the site.

**END OF SECTION 321413**

**SECTION 323120 - ALUMINUM SCREENING AND GATES**

**PART 1 – GENERAL**

## 1.1. DESCRIPTION

A. This section describes the following Mechanical Yard fence system:

1. Semi-private panels fabricated with extruded aluminum planks and structural aluminum profiles including extruded aluminum fence posts and aluminum panel gates. Semi-private panel security screening and gates shall be furnished and installed as shown on the plans and specified herein, overall height of semi private screening shall be as noted on Contract Documents.

## 1.2. REQUIREMENTS

A. Furnish materials, labor, expertise and equipment necessary to complete all work specified in this section and as shown on the drawings.

B. Structural Performance: Provide product and installation capable of withstanding the effects of gravity lads and the following loads and stresses within limits and under conditions indicated.

1. Uniform pressure of 30 lbf/sq. ft. acting inward or outward.
2. Thermal Movements resulting from a temperature change (range) of 120 degrees Fahrenheit ambient and 180 degrees Fahrenheit material surfaces.

## 1.3. SUBMITTALS

A. Shop drawings and manufacturer's literature: Provide specifications and construction detail drawings to substantiate quality of materials and provide details of fabrication and installation.

B. Submittals shall be in accordance with standard construction practices to include complete detailed layout of all panels, posts, gates. Submittals shall include plan layout, elevations and section views of panels, posts and gates.

C. Certificate: manufacturer's certification that materials meet specification requirements.

## 1.4. QUALITY ASSURANCE

A. Installation of fence and materials shall conform to the requirements of the fence manufacturer.

B. The fence shall be warranted from any defects in materials and workmanship for a period as specified in the relevant section of the contract documents.

**PART 2 – PRODUCTS**

## 2.1. MATERIALS

A. Semi-private panel security fence:

2. Material Descriptions:

a. Extruded Aluminum: ASTM B 221, Alloy 6063 – Temper T-6.
b. Sheet Aluminum: ASTM B211, Alloy 6063 – Temper T6.
c. Powder Coating Material Hardness: ASTM 3363 2H.

1. Panel Description:

a. Panel Height: Varies as shown on drawings.
b. Panel Width: As shown on drawings.
c. Semi-private system consisting of horizontal planks fabricated with extruded aluminum framing structural profiles and supported by extruded aluminum fence posts.
d. .938" x 6" tubular slat T-6063 with 1"-2" air gap as shown on plans and based on screen height.
e. Panel Vertical Framework: Minimum 2 ½" x 2 ½" x 1/8" aluminum angle. Framework supporting the semi-private plank screening shall be solid welded and mitered.
f. Panel Horizontal Top Cap: Minimum 2 ½" x 2 ½" x 1/8" aluminum angle
g. Panel Horizontal Bottom Cap: Minimum 2 ½" x 2 ½" x 1/8" aluminum angle

2. Fence Posts:

a. Panel posts shall be Minimum 3" square x 1/8" inch extruded tubular aluminum sections with solid aluminum caps. Length as specified on the contract drawings.
b. On center post spacing shall be as specified by manufacturer.
c. All fence posts to be plated with Minimum 8" x 8" x 5/8" aluminum plates with four ¾" hole for anchors.

3. Fittings and accessories: All fittings and accessories shall be stainless steel and sized as specified by the fence manufacturer. Fence panels to be attached to posts with ¼" x 1" stainless steel screws. Panels and posts are predrilled to support level installation.

4. Anchor Bolts: Anchor bolts shall be minimum 8"x 5/8" threaded and adequate to support loads based on screening height, exposures and loading.

5. Gates: Swing to exterior of enclosure, size as shown on contract drawings.

a. Panel spacing, style and appearance shall be identical to fence panels.
b. Gate hinges to be Gorilla barrel hinge with ¾" rod, ball bearing, and grease zerk. Hinge plate to be ½" thick plates offset to create a 5/8" gap. Standard hardware as required by the gate manufacturer for complete functional operation. Hinges to be bolted to gate frame and field welded to steel gate posts.
c. Gate latch to be internal lock with exterior grab handles. Lock may be keyed and rekeyed. Lock is accessible from both sides of gate.
d. Welded frame, size as shown on the contract drawings, extruded aluminum tubing with aluminum fixed panels to match fencing material.
e. Drop rods to be 1" schedule 40 pipe and through bolted to gate frame.

1. Hardware: Size and type as determined by the manufacturer. Provide three hinges per leaf.

2. Provide 1 inch diameter center cane bolt assembly and strike, each door.

3. Provide padlockable slide bolt assembly.

f. Gate shall have welded frame fabricated from extruded aluminum tubing with aluminum panels to match fencing material. Frame configurations shall be as indicated on the contract drawings.

g. Gate posts shall be as determined by manufacturer. Gate posts to be specified to support gates.

6. Factory Finish: Aluminum fence panels, posts and gates shall receive polyester powder coating.

a. Polyester powder coating: Electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.
b. Color shall be as selected by Architect from full range of colors.
c. Minimum hardness measured in accordance with ASTM D3363 2H.
d. Direct impact resistance tested in accordance with ASTM D2794. Withstand 160 inch-pounds.
e. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95° F and 95% relative humidity after 1,000 hours, less than 3/16 inches undercutting.
f. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted 45°.

7.. Basis of Design: Palm Shield Tiberius or equal by CityScapes, Inc. or Sleekfence Inc.

**PART 3 – EXECUTION**

## 3.1 INSPECTION

A. Verify that final grading in fence location is completed and without irregularities which will interfere with fence installation. PalmShield is designed to be installed on a level surface. Variations in height, slopes, stairs stepping shall be shown on contract drawings and on submittal drawings.

B. Field verify all fence dimensions and layout prior to commencing installation.

C. Do not commence work until unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. Install fence in accordance with manufacturer's installation instructions.

B. Install fence plumb and level. Posts are plated and mounted to top of surface.

C. Do not install bent, bowed or otherwise damaged panels. Remove damaged components from site and replace.

D. Secure fence panels with stainless with ¼" x 1" stainless steel screws to fence posts. All posts and panels will be predrilled to support level installation.

E. Gates

a. Install gates and adjust hardware for smooth operation

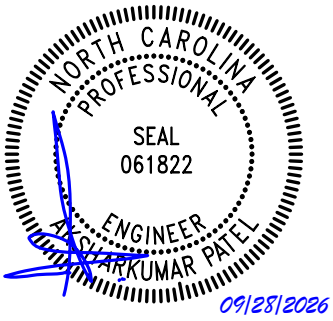
**END OF SECTION 323119**

FIRE PROTECTION SPECIFICATIONS


| | |
|---|---|
| 210500 | GENERAL (FIRE SPRINKLER) PROVISIONS |
| 210513 | ELECTRICAL WORK IN FIRE SPRINKLER CONTRACT |
| 210523 | FIRE SPRINKLER SYSTEM PIPING |
| 210529 | PIPE HANGERS AND SUPPORTS |







## SECTION 210500 – GENERAL REQUIREMENTS FOR FIRE SPRINKLER

## PART 1 - GENERAL

### A. GENERAL

1.1 SCOPE OF WORK

A. The Sprinkler Contractor shall be licensed for sprinkler work.

B. The Sprinkler Contractor shall provide all materials and labor necessary to install a complete and operating sprinkler system in accordance with the Engineering Drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. All work shall be in accordance with State Building Codes, National Fire Protection Association and all applicable codes.

B. The Notice to Bidders, Instructions to Bidders, General Conditions, and Supplementary General Conditions are a part of these specifications.

C. Any inspection and test charges required for the sprinkler work by approving authorities and Owners and any permits needed for installation of a complete system shall be secured and paid for by the Sprinkler Contractor.

D. Where the words "Approved", "Approval", or "Approved Equivalent" appear, it is intended that items other than the model number specified shall be subject to approval of the Engineer.

E. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall require and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.

F. All material and equipment that the Contractor proposes to substitute in lieu of those specified, shall be submitted to the Engineer ten (10) days before the bid date for evaluation. The submittal shall include a full description of the material or equipment and all pertinent engineering data required. Items that are submitted for approval after this date will not be accepted.

G. The Sprinkler Contractor shall refer to the General Conditions for provisions of temporary utilities required under this Contract.

H. All work shall be performed in accordance with U. S. Department of Labor, Occupational Safety and Health Standards.

I. The entire system will be accepted as a unit. There will be no partial acceptance.

J. The Owner shall provide heat in the building to protect the wet pipe system after acceptance of the system and provide all fire extinguishers.

## 1.3 SUBMITTALS

A. See General and Supplementary General Conditions.

B. Within ten days after notification of the award of contract and written notice to begin work the Contractor shall submit to the Architect/Engineer for approval, a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time. Four sets of submittal data shall be provided for approval.

C. Each submittal shall bear the approval of the Contractor indicating he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitutions for specified items. Acceptance for approval shall be in writing from the Engineer.

D. Shop drawings and data sheets shall provide all pertinent information for proper evaluation of each item. The drawings are diagrammatic only and are not intended to show minor details and exact locations. Locations of pipes, ducts, electrical raceways, panels, equipment, light fixtures, ceiling diffusers, etc., shall be reviewed, and anticipated interferences shall be coordinated with other Prime Contractors prior to installation. Lines, whose elevation cannot be changed, shall have the right- of-way, and larger lines shall have the right-of-way over smaller lines. Shop drawings shall show all principal dimensions, "tie-in" dimensions, sizes and locations.

E. The Contractor shall submit to the Engineer a set of accurately marked plans indicating all changes encountered during the construction. Final payment will be contingent on receipt of these As-Built Plans.

F. The Contractor shall furnish four (4) bound sets of maintenance and operating instructions, parts lists, electrical circuit wiring diagrams, all submittal data and sufficient manufacturer's literature to operate and maintain all equipment.

G. The Contractor shall submit to the Owner all certificates required for operating system in compliance with state and federal regulations.

## 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner. Designated areas for material storage will be established by the Owner, and each Contractor will be responsible for maintaining his own area.

B. The Contractor shall protect all material and equipment from breakage, theft, or weather damage. No material or equipment shall be stored on the ground.

C. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.

## 1.5 WORK CONDITIONS AND COORDINATION

A. The Contractor shall review the plans of all other Prime Contractors on the job and inform them of anticipated areas of conflict prior to installation of fire protection system.

B. The Contractor shall review the electrical requirements for the equipment provided and establish points of connection and the extent of electrical work to be provided in his Contract. All electrical work shall be performed by a licensed electrical contracting firm.

C. The Contractor will be responsible for the final electrical connections to all equipment installed as part of his contract. Unless otherwise noted, this Contractor shall wire from his equipment to disconnect switches, junction boxes, or panelboard circuit breakers as provided by the Electrical Contractor.

D. Electrical work by this Contractor shall be in accordance with all state and national codes, and as specified in Division 16 contained herein.

E. Pipe sleeves and chases required for the installation of a complete fire protection system shall be furnished by this Contractor, and he shall be responsible for coordinating the location and correct number of all required openings. The Contractor will be responsible to the General Contractor for coordinating this work with his schedule and will not cause him any undue hardship or loss of time.

F. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be at the Contractor's expense at no extra cost to the Owner.

## 1.6 GUARANTEE

A. Contractor will provide extent and length of warranty and guarantee for all products with his submittals. If no warranties are available or offered, it shall be understood that the Contractor shall guarantee and warrant all materials and labor done under his contract for 12 months from the date of acceptance.

B. Where extended warranties or guaranties are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Owner.

## PART 2 - PRODUCT

2.1 Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Materials and equipment found defective shall be removed and replaced at the Contractor's expense.

2.2 The Contractor shall provide nameplates for identification of all equipment, switches, panels, etc. The nameplates shall be laminated phenolic plastic, black front and back with white core, white engraved letters (1/4" minimum) etched into the white core.

2.3 All materials, products and equipment and components thereof which make up a complete fire protection system, shall be such as appear on the Fire Underwriters Equipment List of the Underwriters Laboratories, Inc.

## PART 3 - EXECUTION

3.1 INSPECTION

A. This Contractor shall examine all areas of completed work prior to installation of the fire protection systems and insure that no defects or errors are present which would result in the poor application or installation of subsequent work.

B. It is the responsibility of this Contractor to coordinate all work performed by others for this Contractor. Upon inspection, should errors or omissions be found, it will be the responsibility of this Contractor to resolve the problem at no cost to the Owner.

3.2 INSTALLATION

A. All work shall be performed in a manner indicating proficiency in the trade.

B. All pipes, conduit, etc., shall be either parallel to the building walls or plumb where installed in a vertical position, unless otherwise noted, and shall be concealed when located in architecturally finished areas.

C. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.

D. All patching shall be done in such a manner as to restore the areas or surfaces to match existing finishes.

E. This Contractor shall familiarize himself with the method and schedule of installation of poured concrete floors and walls. He shall lay out his work in advance and furnish all sleeves and opening locations to the General Contractor for installation. This Contractor shall provide and install all inserts and hangers required to support his equipment, pipes, conduit, etc.

F. All piping and conduit shall be accurately roughed in according to manufacturer's installation dimensions so that no offset adaptors, flexible connections or other imprecision not required by the manufacturer are necessary. All incorrect work shall be torn out and corrected and walls and floors patched at no expense to the Owner.

G. Items such as alarms, valves, test connections, drains, etc., shall be accessible for operating, servicing, maintaining and repairing. Those which are installed in unsuitable locations shall be relocated as directed by the Architect/Engineer at no cost to the Owner.

H. Connections to water, soil and waste lines shall be made a locations shown on the drawings.

## 3.3 PERFORMANCE

A. This Contractor shall perform all excavation and backfill operations necessary for installation of his work.

## 3.4 ERECTION

A. All support steel, angles, channels, pipes or structural steel studs and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided and installed by this Contractor, unless otherwise noted.

## 3.5 FIELD QUALITY CONTROL

A. Testing and Flushing

1. Upon completion of work, inspection and tests shall be made by the Contractor's representative and witnessed by an Owner's representative. All defects shall be corrected and system left in service before a final certificate is issued. The NFPA Contractor's Material and Test Certificate shall be completed and signed by both representatives. Copies shall be prepared for approving authorities, Owner and Contractor.
2. The entire fire protection system, including yard piping, shall be hydrostatically tested at not less than 200 pounds per square inch pressure for two hours or at 50 pounds per square inch in excess of the maximum static pressure when the maximum static pressure is in excess of 150 pounds. The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested.
3. The inside sprinkler piping shall be installed in such a manner that there will be no visible leakage when the system is subjected to the hydrostatic pressure test.
4. The yard piping test shall be made before the joints are covered in order that any leaks may be readily detected. Leakage shall not exceed 2 quarts per hour per 100 joints. It is important to backfill the trench between joints before testing to prevent movement of pipe. The yard piping shall be flushed before connecting to the internal sprinkler system.
5. Instruments, specialties and equipment subject to damage shall be isolated during tests.
6. Prior to final acceptance, each control valve shall be closed and opened under pressure, to insure proper operation.
7. Test of drainage facilities shall be made while the control valve is wide open. The main drain valve shall be opened and remain open until the system pressure stabilizes.

8. Final report forms shall be prepared, delivered to and approval obtained from local authorities, IRI, and any other agency having approval authority and delivered to the Owner. Contractor's Certificate covering materials and tests shall be prepared and delivered to the Owner.

**END OF SECTION 210500**

## SECTION 210513 - ELECTRICAL WORK IN FIRE SPRINKLER CONTRACT

## PART 1 - GENERAL

1.1 This Contractor shall be responsible for the final electrical and the entire control system and control connections to all equipment installed as part of his contract.

1.2 Wiring from disconnect switches, junction boxes, panel board circuit breakers, etc. up to mechanical equipment shall be by the electrical contractor. Final electrical connections to mechanical equipment shall be by this contractor.

1.3 All power and control wiring shall be in conduits.

1.4 All electrical work shall be performed by a licensed electrician.

1.5 All electrical work shall be in accordance with the State Building Code and all its supplements and the latest edition of the National Electrical Code.

## PART 2 - PRODUCT

2.1 All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.

2.2 Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.

2.3 All conductors and conduits shall be sized as noted on the plans or as required per NEC.

## PART 3 - EXECUTION

3.1 All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.

3.2 Electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid- Tite" conduit. Connection to other equipment shall be made with rigid conduit.

3.3 Conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

**END OF SECTION 210513**

## SECTION 210523 – FIRE SPRINKLER SYSTEM PIPING

## PART 1 - GENERAL

1.1 The Sprinkler Contractor shall provide all materials and labor for the installation and make operational a complete sprinkler system.

A. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

1.2 The sprinkler system shall meet all NFPA Standards and approval by governing authorities, and all other authorities having approval jurisdiction shall be received prior to and after installation.

1.3 All materials shall be new, and all materials, products and equipment and components thereof shall be such as appear on the Fire Underwriters' Equipment List of the Underwriters' Laboratories, Inc.

1.4 All grooved joint couplings, fittings, valves, and specialties shall be of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1.5 The Contractor shall provide the Owner with instruction charts describing operation and proper maintenance of sprinkler devices, and a copy of the publication, NFPA 25-2014, entitled Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems.

1.6 Before asking final approval of automatic sprinkler equipment by the authorities have jurisdiction, the Contractor shall furnish a written statement to the effect that the work covered by his Contract has been completed and tested in accordance with the approved specifications and drawings.

1.7 See Section 210500, Item C, EXECUTION, Paragraph 5, Field Quality Control for Acceptance Tests Requirements.

1.8 Testing of all piping shall be made in the presence of the Engineer or designated representative of the Owner. No piping shall be covered or put into operation before such testing has been approved.

## PART 2 - PRODUCT

2.1 Piping

A. Piping 2 1/2" and larger shall be schedule 10, and piping 2 " and smaller shall be schedule 40, black steel pipe conforming to ASTM Specification A795. Other type piping may be submitted for approval only if listed, and it meets the standards cited in NFPA.

B. Standard weight welding fittings shall be used and shall conform to ANSI B16.11.

C. Screwed fittings shall be malleable iron, 150 pounds s.w.p. with banded pattern conforming to ANSI B16.3.

D. Standard riser plate signage shall be provided on each system riser.

E. Grooved end fittings shall be ductile iron and conform to ASTM A536, Grade 65-45-12. Short-pattern, with flow equal to standard pattern fittings.

F. Grooved Joint Couplings: Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12, with pressure-responsive elastomer gasket conforming to ASTM D-2000, and zinc-electroplated carbon steel bolts and nuts conforming to ASTM A-449 and ASTM A-183. Couplings shall comply with ASTM F1476.

1. Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA-13. Installation ready rigid coupling for direct stab installation without field disassembly.

a. Couplings shall be fully installed at visual pad-to-pad offset contact. Tongue and recess type couplings, which require the use of a torque wrench to achieve the exact required gap between housings, are not permitted.

2.2 Sprinkler Heads

A. Only listed sprinkler heads shall be used. Sprinkler heads shall not be altered in an respect, nor have any type of ornamentation or coatings applied after shipment from the place of manufacture.

B. Sprinkler body shall be integrally cast with a hex shaped wrench boss to reduce the risk of damage during installation. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss. (Sprinklers shall not contain rubber O-rings.)

C. Guards shall be furnished wherever heads will be subject to damage. Provide guard on heads in janitor’s closet.

D. Guards and escutcheons shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

E. The Contractor shall provide the Owner a cabinet containing a minimum of 6 spare sprinklers of each type used in the installation. A special sprinkler wrench shall also be provided to be used in the removal and installation of sprinklers. Mount cabinet adjacent to riser.

F. Where possible, all sprinkler heads shall be trimmed with materials to allow ceiling tile replacement.

G. Multiple-Use Flexible Drop System: In lieu of rigid pipe offsets or return bends for sprinkler drops may be used to locate sprinklers as required by final finished ceiling tiles and walls. Head and flexible piping shall bear UL 2443 listing.

1. The drop shall include a UL approved 304 stainless steel braided hose with a bend radius to 2" to allow for proper installation in confined spaces. The hose shall be limited to 60". Hose diameter shall have a 1" true bore internal diameter.
2. Union joints shall be provided for ease of installation.
3. The flexible drop shall be permanently attached to the ceiling. Attach to the ceiling grid using a one-piece open gate bracket and tamper resistant screws. The bracket shall allow installation before the ceiling tile is in place.
4. The braided drop system is UL listed and FM Approved for sprinkler services to 175 psi (1206 kPa).
5. Hose shall connect to side or top of branch piping.
6. Hydraulic calculations shall be based on actual pressure drop losses published by the manufacturer.

## 2.3 Sprinkler Alarms

A. Alarm check valve of the approved type with water motor alarm gong, riser trim, drain valves and riser lines shall be located at the main system control valve as indicated on the Drawings.

1. Valve internal components shall be replaceable without removing the valve from the installed position.

B. flow switches are to be furnished and installed by the Sprinkler Contractor.

C. Wiring from flow switches and alarm valves to fire alarm control panel shall be by Electrical Contractor.

## 2.4 Gauges

A. Approved pressure gauges shall be installed as indicated on the Drawings. The gauge connection shall be equipped with a shut-off valve and with provision for draining.

B. The pressure gauges shall be of approved type and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal and shall be located where they will not be subject to freezing.

## 2.5 Fire Department Connections

A. Approved equipment shall be by Crocker, Seco, Standard, W. D. Allen, or Elkhart, or approved equivalent.

B. Sprinkler alarms shall be installed as required by NFPA or local authorities for a complete sprinkler system.

C. Wiring from tamper switches and flow switches to fire alarm control panel shall be by the Electrical Contractor.

2.6 Valves

A. Shut-off valves shall be butterfly type with grooved ends or 125# flanges. The valve seat shall be pressure responsive, and the stem shall be offset from the disc centerline to allow complete 360 degree circumferential seating. Valve shall be provided with a weatherproof actuator with two SPDT supervisory switches with position indicating tab.

B. Check valves shall be grooved end or flanged type with spring-assist. Valve shall be capable of being mounted vertically or horizontally.

C. Inspector's Test Valve: Provide inspector's test valve and piping as shown on the Drawings.

D. Standard design identification signs shall be provided on all control drain, test and alarm valves.

**PART 3 - EXECUTION**

3.1 Pipe 2" and smaller shall have screwed joints.

3.2 Pipe 2 1/2" and larger shall be welded or grooved ends. Welding of pipe shall be in accordance with NFPA 13, Chapter 3-3.12.4.

3.3 Welding ties or weldolets shall be used.

3.4 No "stub-in" shall be permitted.

3.5 When risers are 3" and larger in size, a flange joint shall be used at the riser where required.

3.6 Screwed unions shall not be used on pipe larger than 2". Couplings and unions of other than screwed type shall be of types approved specifically for use in the sprinkler systems.

3.7 Grooved joint couplings and fittings shall be installed in accordance with the manufacturer’s written installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s

representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

3.8 A one-piece reducing fitting shall be used wherever a change is made in the size of the pipe, except hexagonal or face bushings may be used in reducing the size of the openings of fittings when standard fittings of the required size are not available.

3.9 Hangers supporting horizontal piping shall be installed and spaced in accordance with NFPA 13, Chapter 3-3.14.

3.10 Sleeves shall be provided wherever pipes pass through walls, floors, and ceilings. Sleeves shall be schedule 40, black steel, 1/2" in diameter larger than the pipe or insulation on the pipe. Sleeves through wall and ceiling shall be flush. Sleeves through floors shall extend one inch above finished floor. Sleeves in exterior walls shall be caulked and made watertight. Pipes passing through sleeves shall be painted with a rust inhibiting paint. Pipes passing through fire walls or floors shall be sealed to conform to Underwriters' Laboratories requirements.

3.11 Installation of hangers and inserts shall be coordinated with all other Contractors on a priority basis. Each Contractor shall be responsible for providing all inserts, hangers, and rods necessary for the installation of his work.

3.12 Spacing, location and position of sprinkler heads and piping are approved on plans and shall be in accordance with minimum standards set forth in NFPA 13, Chapter 3.

3.13 All sprinkler heads, unless otherwise noted, will be centered in ceiling tiles.

3.14 All sprinkler heads, unless otherwise noted, will be installed on a swing connection.

3.15 Do not install sprinklers that have been dropped or show a visible loss of fluid. Never install sprinklers with cracked bulbs.

3.16 The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.

3.17 All piping tests for the sprinkler system shall be in accordance with NFPA 13, Chapter 1-1.11.3. A Contractor's Material and Test Certificate Part "C" will be filled out for each riser by the Contractor and signed with copies prepared for approving authorities, Owner, and Architect/Engineer. Any leaks that occur shall be repaired and another test started. All defects shall be corrected and the system left in service before the Contractor leaves the job.

**END OF SECTION 210523**

## SECTION 210529 – FIRE SPRINKLER PIPE HANGERS AND SUPPORTS

### PART 1 - GENERAL

1.1 This Section includes hangers and supports, etc. as may be required to provide a complete sprinkler piping system.

1.2 The actual arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainage, etc. shall be maintained.

### PART 2 - PRODUCT

2.1 Piping shall be as stated in Section 210523.

2.2 Hangers and Supports shall be as follows:

| | |
|---|---|
| Concrete Inserts | Fig. B2500 |
| Hanger Rod | Fig. B3205 |
| Riser Clamp | Fig. B3373 |
| Hanger | Fig. B3100 |
| Pipe Saddles | Fig. B3160 |
| Insulating Protector | Fig. B3151 |
| Rod Ceiling Plate | Fig. B3199 |
| Beam Clamps | Fig. 3050 |
| Offset Clamps | Fig. B351L |
| Roller Hanger | Fig. B3110 |

Figure numbers given above are devices as manufactured by B-Line Systems, Inc.

### PART 3 - EXECUTION

3.1 Hangers supporting horizontal piping shall be spaced in accordance with NFPA 13.

3.2 Hangers shall be provided at each change in direction. Vertical risers shall be supported at each floor, 5 feet on center and/or at changes in direction of pipe.

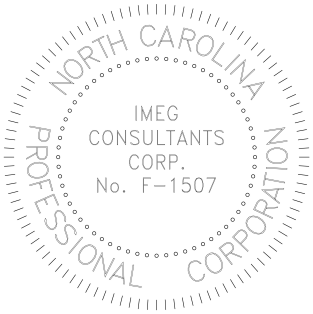
3.3 Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be schedule 40, black steel, 1/2" diameter larger than the pipe or insulation on the pipe. Sleeves

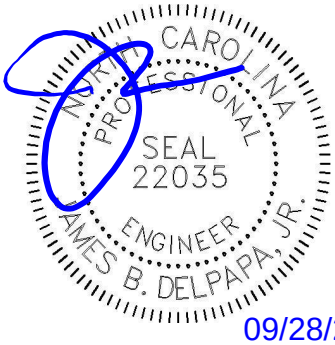
through walls and ceilings shall be flush. Sleeves through floors shall extend one inch above finished floor. Sleeves in exterior walls shall be caulked and made watertight.

**END OF SECTION 210529**

PLUMBING SPECIFICATIONS


| | |
|---|---|
| 220500 | GENERAL (PLUMBING) PROVISIONS |
| 220513 | ELECTRICAL WORK IN PLUMBING CONTRACT |
| 220523 | VALVES |
| 220529 | PIPE HANGERS AND SUPPORTS |
| 220553 | IDENTIFICATION OF PLUMBING COMPONENTS |
| 220700 | PLUMBING INSULATION |
| 221000 | PIPE AND PIPE FITTINGS |
| 221119 | PIPING SPECIALTIES |
| 224000 | PLUMBING FIXTURES |


09/28/2026

## SECTION 22 05 00 – PLUMBING GENERAL PROVISIONS

## PART 1 - GENERAL

1.1 Scope of Work

A. The Contractor shall provide all materials, equipment and labor necessary to install and set into operation a complete plumbing system as shown on the engineering drawings and as specified herein.

1.2 Quality Assurance

A. See the General and Supplementary General Conditions.

B. All work shall be in accordance with State Code and Underwriter's Regulations. Minimum requirements shall be the State Plumbing Code.

C. Wherever the words "Approved", "Approval", or "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.

D. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.

E. All material and equipment that the Contractor proposes to substitute in lieu of those specified shall be submitted to the Engineer ten (10) days before the bid date for evaluation. The submittal shall include a full description of the material or equipment and all pertinent engineering data required to substantiate the equality of the proposed item to that specified. Items that are submitted for approval after this date will not be accepted. Section 01600 of the General Conditions will be followed for substitutions after award of the contract. Submittals

F. See General and Supplementary General Conditions.

G. Within twenty days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit to the Architect/Engineer for approval a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time. Six (6) sets of submittal data shall be provided for approval

H. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number, and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitutions for specified items. Acceptance for approval shall be in writing from the Engineer.

I. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent upon receipt of these as-built plans.

J. The Contractor shall furnish four (4) bound sets of maintenance and operating instructions as outlined in Paragraph C, (Execution), Item #6, of this specification section.

K. The Contractor shall submit to the Owner all certificates required for operating the system in compliance with the plans and specifications.

1.3 Product Delivery, Storage and Handling

A. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.

B. The Contractor shall protect all material and equipment from breakage, theft, or weather damage. No material or equipment shall be stored on the ground.

C. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.

1.4 Work Conditions and Coordination

A. The Contractor shall review the electrical plans to establish points of connection and the extent of electrical work to be provided in his Contract. A licensed electrician shall perform all electrical work.

B. Electrical work shall be in accordance with State codes, and as specified in Division 16 contained herein.

C. Pipe chases required for installation of work shall be provided by the General Contractor unless otherwise noted. This Contractor shall be responsible for coordinating the location of all required chases.

D. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be at the Contractor's expense at no extra cost to the Owner.

1.5 Guarantee

A. Where items of equipment or material carry a manufacturer’s warranty for any period in excess of twelve (12) months, then the manufacturer’s warranty shall apply for that particular piece of equipment or material. The contractor shall replace such defective equipment or materials, without cost to the owner, within the manufacturers warranty period.

B. The contractor shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve (12) months following the finals acceptance of the work an shall replace such defective materials or workmanship without cost to the owner.

C. Additionally, the contractor shall guarantee materials and workmanship against latent defects arising from faulty materials, faulty workmanship or negligence which is hidden or not readily apparent to the owner at the time of final acceptance and which is discovered by the owner within six (6) years following final acceptance of the work. The contractor shall replace such defective materials or workmanship without cost to the owner.

**PART 2 - PRODUCT**

2.1 Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Material and equipment found defective shall be removed and replaced at the Contractor's expense.

2.2 The Contractor shall provide nameplates for identification of all equipment, switches, panels, etc. The nameplates shall be laminated phenolic plastic, black front and back with white core, white engraved letters (1/4" minimum) etched into the white core. Nameplates shall be fastened with pan head tapping screws.

**PART 3 - EXECUTION**

3.1 Inspection

A. This Contractor shall examine the areas of completed work and shall insure that no defects or errors are present which would result in the poor application or installation of subsequent work.

3.2 Installation

A. All work shall be performed in a manner indicating proficiency in the trade.

B. All pipes shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.

C. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.

D. All finishing shall be by the General Contractor.

E. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish all sleeves to the General Contractor for openings through poured masonry floors or walls, above grade, required for passage of all pipes required to support his equipment.

F. All fixtures shall be accurately roughed in according to the manufacturer's installation dimensions so that no offset adaptors, flexible connections or other improvising are necessary. All incorrect work shall be torn out and corrected and walls and floors patched.

G. Connections to cold water, soil and waste lines shall be made at locations shown on the Drawings.

3.3 Performance

A. The Contractor shall perform all excavation and backfill operations necessary for installation of his work.

B. Rock excavation shall be defined in the Supplementary General Conditions. Unless specifically stated, neither rock excavation nor a unit price for rock excavation shall be required in the bid.

3.4 Erection

A. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.

3.5 Adjust and Clean

A. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.

B. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for intended service. In no event shall nameplates be painted.

C. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract.

3.6 Maintenance and Operating Manual

A. The Contractor shall prepare four (4) copies of a manual describing the proper maintenance and system operation. This manual shall not consist of standard factory printed data intended for dimension or design purposes (although these may be included) but shall be prepared to describe this particular job. This manual shall include the following:

1. Index and page numbers.
2. Certificate of substantial completion.
3. A summary sheet of warranties with the dates noted and a copy of all warranties.
4. List of all subcontractors and suppliers with names, addresses and phone numbers.
5. Certified testing and balancing report.
6. All submittal data and shop drawings.

B. The O & M manuals shall be installed in 3 ring heavy back note books with the name of the building and the words, “Operations and Maintenance Manuals” permanently affixed to the cover and spine.

C. The operating and maintenance manuals shall be submitted to the Engineer (2) weeks before the pre-final inspection, for approval. When the manuals are considered complete by the Engineer, they will be turned over to the Owner for their permanent use.

**END OF SECTION 22 05 00**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 05 13 - ELECTRICAL WORK IN PLUMBING CONTRACT**

PART 1 - GENERAL

1.1 This Contractor shall be responsible for the entire control system and control connections to all equipment installed as part of his contract.

1.2 Wiring from disconnect switches, junction boxes, panelboard circuit breakers, etc. up to plumbing equipment shall be by the electrical contractor. Refer to details on plans for connections to equipment from starter/disconnects.

1.3 All power and control wiring shall be in conduit.

1.4 All electrical work shall be performed by a licensed electrician.

1.5 All electrical work shall be in accordance with the State Building Code and all its supplements and the latest edition of the National Electrical Code.

PART 2 - PRODUCT

2.1 All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.

2.2 Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.

2.3 All conductors and conduits shall be sized as noted on the plans or as required per NEC.

PART 3 - EXECUTION

3.1 All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.

3.2 Control wiring electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid- Tite" conduit. Connection to other equipment shall be made with rigid conduit.

3.3 Control wiring conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

**END OF SECTION 22 05 13**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 05 23 - VALVES**

PART 1 - GENERAL

1.1 Valves shall be installed where indicated or required.

1.2 Insofar as possible, all valves shall be by the same manufacturer.

1.3 All valves stored on project site shall have ports closed.

1.4 Valves shall serve dual functions as shut-off and balancing valves.

1.5 Valves shall have an adjustable set point with locking mechanism which will permit closing of the valve and reopening of the valve to the previously determined set point.

PART 2 - PRODUCT

2.1 Isolation/Shutoff valves up to and including 3" in line size shall be full port, forged brass ball valves with threaded ends, Watts Series FBV-1 or approved equivalent.

2.2 Isolation/Shutoff valves 4" and larger shall be full port, 125# class, epoxy coated cast iron, flanged ball valves suitable for potable water service, FDA approved, Watts Series G-4000-FDA or approved equivalent

2.3 Provide stem extensions, as necessary, to accommodate piping insulation.

PART 3 - EXECUTION

3.1 All flanged connections shall be gasketed.

3.2 In no case shall raised face flanges be bolted to flat face flanges.

3.3 All valve stems shall be accessible and in no case shall valve stems be installed below horizontal.

3.4 The Contractor shall set in service all valves to operating conditions as part of his Contract.

3.5 The contractor shall provide 1" diameter brass valve tags for all valves.

3.6 The contractor shall provide ceiling markers for ceilings above lay-in ceiling.

3.7 The contractor shall provide a framed valve chart.

**END OF SECTION 22 05 23**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 05 29 - PIPE HANGERS AND SUPPORTS**

PART 1 - GENERAL

1.1 This Section includes all hangers and supports, etc. as may be required to provide a complete piping system.

1.2 The actual arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainage, etc. shall be maintained.

1.3 Refer to specification Section 221000 for piping.

PART 2 - PRODUCT

2.1 Piping shall be as stated in Piping Section(s).

**2.2** Hangers and supports shall be as manufactured by B-Line Systems, Inc., PHD Manufacturing, Empire, or Modern Support Devices.

PART 3 - EXECUTION

3.1 In no case shall this Contractor be allowed to cut or reduce the specified covering to allow the application of a smaller hanger than required.

3.2 Hangers shall be spaced as dictated by North Carolina Plumbing Code.

3.3 Hangers shall be provided at each change in direction.

3.4 Vertical risers shall be supported at each floor, 5 feet on center, and/or at changes in direction of pipe.

3.5 Do not support piping from bar joist bridging and/or roof deck.

**END OF SECTION 22 05 29**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 05 53 – IDENTIFICATION OF PLUMBING COMPONENTS**

PART 1 - GENERAL

1.1 This section includes insulation for piping and equipment, as shown on the plans.

1.2 All coverings, and adhesives shall have a flame spread classification of 25 or less and a smoke developed rating of not more than 50.

PART 2 - PRODUCT

PART 3 - EXECUTION

3.1 EQUIPMENT

A. All water heaters shall be identified with equipment identification, equipment controlled, electrical ratings and date of installation.

B. Equipment shall be clearly identified with engraved phenolic plates securely fastened to the equipment with sheet metal screws. Phenolic plates shall be white background and black lettering.

C. All serviceable equipment located above ceilings or other concealed spaces shall clearly identified on an adjacent finished surface below service space. Label shall be engraved phenolic plate with white background and white letters. Label shall list name of equipment.

3.2 PIPING AND VALVES

A. Valve Identification

1. Project specific equipment
2. All valves shall be tagged brass valve tags with chains for isolation and control valves.
3. Provide valve tag chart in the O&M manual.
4. Provide famed valve tag chart with lexan cover mounted in each mechanical room. Chart shall include all valves in that room.
5. Include the tag numbers in the as-built drawings.
6. Provide ceiling marker for isolation valves about lay-in ceilings.

B. All piping shall be provided with identification in accordance with ANSI A13.1-1981 standards. Markets shall be fully legible from floor level showing medium contained pipe, and direction flow. Stenciling as indicated below will be acceptable in lieu of markers.

C. Locate pipe markers and flow arrows as follows:

1. Maximum of 10ft and closer if congested.
2. Near each valve

3. Near each branch take off.
4. Near equipment.
5. Near origination and termination points
6. Near where pipe passes through walls (both sides of wall)
7. Near access doors
8. On piping above inaccessible ceilings as it enters and immediately after it exits.

D. All exposed piping in mechanical rooms shall be painted and marked as listed below:

| **Piping System** | **Color** | **Sherwin Williams Number** | **Lettering** |
|---|---|---|---|
| Dom. Cold Water | Dark Blue | SW6965 | CW |
| Dom. Hot Water | Light Red | SW6868 | HW |
| Dom. Hot Water Return | Light Red | SW6868 | HWR |
| Natural Gas | Yellow | SW6911 | GAS |

E. Pipe identification shall contrast in color to the pipe colors and be easily readable. The width of color bands should be equal to the size of the stencil indicated below.

**END OF SECTION 22 05 53**

**SECTION 22 07 00 - PIPE INSULATION**

PART 1 - GENERAL

1.1 The Contractor shall insulate hot water supply and return, and cold water piping as specified below.

1.2 All insulation, linings, coverings and adhesives shall have a flame spread classification of 25 or less and a smoke developed rating of not more than 50, except for exposed outside piping.

PART 2 - PRODUCT

2.1 All hot and cold water piping (unless otherwise noted) shall be insulated with 1" thick fibrous glass materials with factory applied cover. All hot and cold water piping located in unconditioned spaces shall be insulated with 1 1/2" thick fibrous glass materials with factory applied cover. Cover shall be embossed vapor barrier, laminated with pressure sealing cap adhesive.

2.2 Closed cell insulation, of equal R-value may be used in lieu of fiberglass where concealed in walls. Insulation joints are to be sealed per manufacturer's recommendations. Taped joints will not be accepted. Insulation shall be finished with a fire retardant coating to attain proper fire rating.

2.3 All exposed piping in finished areas and equipment spaces shall have an additional layer of Kraft paper with vapor sealing tape followed by 8oz. /sq.yd. canvas cloth wrap, glued with two coats of sizing. Canvas shall be coated twice with Foster fireproof lagging to assure flame and smoke spread ratings.

PART 3 - EXECUTION

3.1 Insulation shall be installed in accordance with manufacturer's recommendations.

3.2 All exterior piping insulation above grade shall be provided with a protective aluminum jacket with a factory-applied asphalt and Kraft paper moisture barrier. Aluminum jackets shall be cross-cirmped (longitudinally corrugated) for strength. Aluminum jackets shall be not less than 0.106" thick and shall be secured with aluminum or stainless steel screw; not more than 8" apart.

3.3 All piping exposed outdoors shall be wrapped with electric trace before insulation is applied.

3.4 Any pipe covered prior to leak testing shall be exposed at contractor expense.

3.5 All piping shall be provided with identification in accordance with ANDI A13.1-1981 standards. Markers shall be located at each wall, floor, and ceiling penetration, and at every 25ft (10 feet in mechanical rooms). Markers shall be fully legible from floor level showing medium contained in pipe, and direction of flow. Wording on markers shall be as follows:

A. “Domestic Cold Water Supply”.

B. “Domestic Hot Water Supply”.

3.6 Provide sheet metal saddle at each hanger. Provide wood blocking at each saddle.

**END OF SECTION 22 07 00**

**SECTION 221000 - PIPE AND PIPE FITTINGS**

PART 1 - GENERAL

1.1 This section includes all pipe, pipe fittings, hangers, and supports, etc. as may be required to provide a complete water plumbing system.

1.2 The actual arrangement of the piping shall follow the general locations shown on the drawings, such that clearances, line drainage, etc. shall be maintained.

1.3 Refer to Specification Section 22 05 23 Plumbing Valves

1.4 Refer to Specification Section 22 05 29 Plumbing Hangers.

1.5 Refer to Specification Section 22 05 53 Identification of Plumbing Components.

1.6 Refer to Specification Section 22 07 00 Plumbing Insulation.

1.7 Refer to Specification Section 22 11 19 Plumbing Piping Specialties.

PART 2 - PRODUCT

2.1 Domestic Water Pipe and Pipe Fittings

A. Copper Pipe

1. Water piping above grade shall be Type “L” hard drawn copper. Water piping below grade shall be Type “K” soft drawn. Pipe shall conform to ASTM B-88 Specification.
2. Water piping fittings shall be sweat or grooved type wrought copper conforming the ANSI-B16.22, ASME B16.18, or ASTM B584 Specification.
3. Use silver solder or grooved couplings (Victaulic Style 607) on all piping.
4. Grooved Pipe Joint Construction: Square cut pipe ends and roll groove ends of pipe in accordance to manufacturer’s specifications. Gaskets shall be verified as suitable for the intended service and shall be coated on the lips with a thin uniform coat of lubricant in accordance with the manufacturer's published instructions. For installation-ready coupling housing shall engage both grooves, otherwise the housing shall be assembled over the gasket and shall engage both grooves The nuts shall be uniformly tightened until the housing pads are firmly together metal to metal, or until properly tightened per manufacturer’s specifications and instructions. A factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).) To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products and grooving tools utilized shall be supplied by a single manufacturer. Grooved butterfly valves may be utilized on grooved copper piping systems; Victaulic Series 608.
5. All piping systems shall be hydrostatically tested at 150 psi for a period of 48 hours without loss of pressure. Any leaks that occur shall be repaired and another test started.

2.2 Storm, Sanitary Waste and Vent Pipe and Pipe Fittings

A. PVC Pipe

1. Building sanitary sewer and storm lines below grade shall be schedule 40 PVC-DWV conforming to ASTM D-2665-68.
2. Building sanitary sewer, storm, and vent lines above grade shall be schedule 40 PVC-DWV conforming to ASTM D-2665-68.
3. PVC fittings to conform to piping specifications.
4. Joints for PVC piping shall be made using the piping manufacturer's approved solvent cement.
5. Waste pipe shall be tested at each floor. A test tee will be installed below each floor and pipe will be filled with water for a height of 10' above finished floor. The pipe shall be gas and water tight. Water shall stand in the system for a period of 3 hours without evidence of leakage.
6. PVC piping is not permitted in return air plenums.
7. PVC piping is not permitted for dishwasher waste. Cast iron piping is to be used.

PART 3 - EXECUTION

3.1 Sleeves shall be provided wherever pipes pass through walls, floors, and ceilings. Sleeves shall be Schedule 40, black steel, ½" in diameter larger than the pipe or insulation on the pipe. Sleeves through floors shall be caulked and made watertight.

3.2 In pipe chases, the Contractor shall provide for suspension of all piping from the structure. Do not allow piping to rub against masonry when expanding and contracting.

3.3 Close and protect open ends of piping until final connections are made. Such closing shall be made with fittings which cannot be easily removed. Caps or plugs shall be required at all times during construction so that no pipes are left open at the end of any day's work, even though continuation is expected the next day.

3.4 All piping and equipment installed under this Contract shall be tested in the presence of the Engineer or a designated representative of the Owner, and the proper Plumbing Inspector, proved tight for the periods stated above, or longer if required by the Inspector. Engineer shall be given 48 hour written notification of all tests.

3.5 No plumbing system or part thereof shall be covered or concealed until after it has been tested and approved. If such work has been covered or concealed before testing, it shall be exposed for testing.

3.6 All water piping shall be sterilized with chlorine, 50 milligrams per liter, and held for a 24-hour period, after which the system shall be flushed prior to being put into service. During the flushing of the system, all flush valves shall be thoroughly flushed out to insure the removal of sediment, pipe dope, etc., from water lines and flush valves, removing such working parts of the flush valves as may be deemed necessary. The system shall be drained and flushed sufficiently to provide chlorine residue of 0.2 ppm or less.

**END OF SECTION 22 10 00**

**SECTION 22 11 19 - PIPING SPECIALTIES**

PART 1 - GENERAL

1.1 This Section includes miscellaneous items required for a complete plumbing system.

PART 2 - PRODUCT

2.1 Escutcheons shall be chrome plated, spring type, on all pipes passing through walls and ceilings in finished areas. Floor escutcheons shall be cast brass, chrome plated, with set screw.

2.2 Stops shall be compression type, chrome plated, angle or straight way pattern on all fixtures, hot and cold water supply. On service sinks, use brass gate valve as specified.

2.3 Flashing for vents through the roof shall be two-piece type, 16 ounce copper counter flashing and base flashing, or a two-piece type, 4 pound lead counter flashing and base flashing. The base flashing shall be installed by the General Contractor with the roof system.

2.4 Pipe anchors for rough-in use shall be "Rapid Rough" products. Use for anchoring rough-in of all hot and cold water connections for all lavatories, sinks and other wall connected fixtures.

2.5 Insulating couplings shall be V-line, as manufactured by Walter Vallett or approved equal.

2.6 Shock absorbers shall be of all stainless steel construction and in conformance with P. D. I. Standard WH201. Shock absorbers shall be installed as noted at the locations shown on the plans and shall be totally accessible. Where there are no shock absorbers noted or shown on the plans, 18 inch air chamber type shock absorbers shall be installed at the hot and cold water supply to each fixture.

2.7 Unions shall be bronze body with packless brass ground joints. Wrought iron pipe unions shall be malleable iron, ground joint with bronze to iron seat.

PART 3 - EXECUTION

3.1 Escutcheons shall be of sufficient size to cover outside diameter of the pipe or the insulation of the pipe.

3.2 Vent flashing shall extend down at least 4 inches from the top of the pipe. Flashing shall extend at least 12 inches in all directions from the pipe and shall be parallel to the roof line.

3.3 Pipe anchors for rough-in use shall be installed to hold pipes securely in alignment, according to the manufacturer's rough-in dimensions. Remove these devices after the wall is built around the pipes.

3.4 Unions shall be installed as shown on the plans, and where required, to disconnect piping for

future replacement or repairs.

3.5 Dielectric unions shall be installed at hot water heaters and at any junction of dissimilar metal pipes.

**END OF SECTION 22 11 19**

## SECTION 22 40 00 – PLUMBING FIXTURES

## PART 1 - GENERAL

1.1 Provide plumbing fixtures as scheduled on the drawings.

1.2 All fixtures shall be by one manufacturer insofar as possible.

1.3 Submit shop drawings on the following:

A. Fixtures

B. Floor drains and cleanouts

C. Trim

1.4 All china fixtures are to be white.

1.5 All faucets, shower valves, trim, escutcheons to be chrome plated unless otherwise noted on the plans

## PART 2 - PRODUCT

2.1 Products approved for use on this shall be as follows:

A. Fixtures: Kohler, American Standard, Eljer, Zurn, Toto, Crane

B. Stainless steel sinks: Elkay, Just

C. Flush Valves: Sloan, Delaney, Zurn

D. Floor drains and cleanouts: Zurn, Smith, and Josam.

E. Trim: Kohler, American Standard, Eljer, Chicago Faucets, T & S Brass and Bronze, Delta, Symmons, Sloan, Delaney, Stern-Williams, McGuire, Brasscraft, Cambridge Brass, Speakman, Zurn, Moen.

## PART 3 - EXECUTION

3.1 Fixtures and carriers shall be installed in accordance with the manufacturer's recommendations.

3.2 All fixtures, drains, traps, etc. shall be set plumb and level.

3.3 All handicapped fixtures and trim shall be installed in accordance with the State Building Code,

latest edition.

3.4 Provide trap primer and required piping on all floor drains.

3.5 All fixtures are to be water saving type.

3.6 Provide vandal-proof options for all fixtures used by public. This includes screws, aerators, and showerheads.

3.7 Wiring for hard wired sensor faucets and flush valves to be run in conduit.

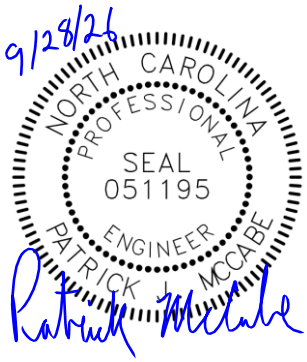
**END OF SECTION 22 40 00**

MECHANICAL SPECIFICATIONS


| | |
|---|---|
| 230500 | BASIC HVAC REQUIREMENTS |
| 230503 | THROUGH PENETRATION FIRESTOPPING |
| 230513 | MOTORS |
| 230515 | VARIABLE FREQUENCY DRIVES |
| 230529 | HVAC SUPPORTS AND ANCHORS |
| 230548 | HVAC VIBRATION ISOLATION |
| 230553 | HVAC INDENTIFICATION |
| 230593 | TESTING, ADJUSTING, AND BALANCING |
| 230713 | DUCTWORK INSULATION |
| 230716 | HVAC EQUIPMENT INSULATION |
| 230719 | HVAC PIPING INSULATION |
| 230800 | COMMISSIONING OF HVAC |
| 230900 | CONTROLS |
| 230993 | BAS SEQUENCE OF OPERATIONS |
| 231123 | NATURAL GAS PIPING |
| 232100 | HYDRONIC PIPING |
| 232116 | HYDRONIC SPECIALTIES |
| 232123 | HVAC PUMPS |
| 232300 | REFRIGERATION PIPING AND SPECIALTIES |
| 232500 | CHEMICAL (WATER) TREATMENT |
| 233100 | DUCTWORK |
| 233300 | DUCTWORK ACCESSORIES |
| 233416 | CENTRIFUGAL FANS |
| 233600 | AIR TERMINAL UNITS |
| 233700 | AIR INLETS AND OUTLETS |
| 235216 | CONDENSING BOILERS |
| 236213 | AIR COOLED CONDENSING UNITS |
| 236430 | AIR COOLED WATER CHILLERS |
| 237313 | INDOOR MODULAR AIR HANDLING UNITS |
| 238126 | SPLIT SYSTEM AIR CONDITIONING UNITS |
| 238145 | VARIABLE REFRIGERANT FLOW HEAT PUMPS |
| 238200 | TERMINAL HEAT TRANSFER UNITS |







**THIS PAGE INTENTIONALLY LEFT BLANK**

## SECTION 23 05 00 - BASIC HVAC REQUIREMENTS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 23 Sections. Also refer to Division 01 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Scope of Work:

1. Plumbing Work: Refer to Section 22 05 00 "Basic Plumbing Requirements".
2. Heating Work shall include, but is not necessarily limited to:

    a. Furnish and install heating hydronic boilers and accessories.
    b. Furnish and install complete heating water system including pumps, piping, insulation, air control equipment, terminal heating equipment, and specialties. Make final connections to all coils, including those furnished by others.
    c. Furnish and install complete reheat water system including pumps, piping, insulation, air control equipment, specialties, and connections to terminal heating coils.
    d. Furnish and install complete gas piping system including all meter requirements.
    e. Furnish and install chillers and cooling towers.
    f. Furnish and install complete chilled water system including pumps, piping, insulation, air control equipment, terminal cooling equipment, and specialties. Make final connections to all coils, including those furnished by others.
    g. Furnish and install refrigerant piping, accessories, and final charge of refrigerant.

h. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.
i. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
j. Complete all applicable tests, certifications, forms, and matrices.

3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:

a. Furnish and install built-up air handling units complete with louvers, dampers, filters, coils, fans, motors, housing, and vibration isolation.
b. Furnish and install air-cooled condensing units and curbs.
c. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
d. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
e. Furnish and install all terminal air boxes and reheat coils.
f. Furnish and install combustion air louver, damper, and ductwork.
g. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.
h. Furnish and install mechanical room ventilation systems including louvers, ductwork, insulation, and fans.
i. Furnish and install gas flues, stacks, and breechings.
j. Furnish and install all temperature control systems.
k. Furnish and install all fire dampers.
l. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
m. Complete all applicable tests, certifications, forms, and matrices.

4. Temperature Control Work shall include, but is not necessarily limited to:

a. Furnish and install a complete temperature control system as specified in Section 23 09 00.
b. Temperature control system shall consist of a full Direct Digital Control (DDC) system including all accessories, sensors, and programming.
c. Furnish automatic control valves and dampers for installation by others.
d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

5. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:

a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.
b. Complete all applicable tests, certifications, forms, and matrices

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:

    a. Plumbing Contractor.
    b. Heating Contractor.
    c. Air Conditioning and Ventilating Contractor.
    d. Temperature Control Contractor.
    e. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

    a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

| Distribution/Nominal Voltage | Utilization Voltage |
|---|---|
| 120 | 115 |
| 208 | 200 |
| 240 | 230 |
| 277 | 265 |
| 480 | 460 |

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:

    a. Light fixtures.
    b. Gravity flow piping, including steam and condensate.
    c. Electrical busduct.
    d. Sheet metal.
    e. Electrical cable trays, including access space.
    f. Sprinkler piping and other piping.
    g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:

    a. Burners.
    b. Chillers.
    c. Computer Room Air Conditioning Units.
    d. Condensing Units.
    e. Makeup Air Units.
    f. Gas Trains.

2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
4. Temperature Control Contractor's Responsibility:

    a. Wiring of all devices needed to make the Temperature Control System functional.
    b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor.
    c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provide power to M.C. provided disconnects for mechanical equipment. Provide power from disconnect to equipment. See Typical Wiring Detail on drawings for more information.
2. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
3. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

## 1.4 COORDINATION DRAWINGS

A. Provide coordination drawings showing the complete, coordinated installation of mechanical, electrical, plumbing, fire protection, and other systems within available building spaces.

B. Definitions:

1. Coordination Drawings: Coordination drawings are defined as composite drawings or models that incorporate work of multiple trades and demonstrate coordinated routing, elevations, and clearances.

    a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
d. Maintenance clearances and code-required dedicated space shall be included.
e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. Provide one complete, composite coordination drawing package for each building area, system, or phase demonstrating fully coordinated conditions.
3. The composite coordination drawing package may be created from multiple trade-specific electronic files; however, the final deliverable shall clearly represent a single coordinated installation.
4. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.

    a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.

5. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

C. Participation:

1. The Contractor shall be responsible for coordinating all trades and preparing coordination drawings.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the [Mechanical Contractor].

    a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

D. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

    a. Scale of drawings:

        1) General plans: 1/4 Inch = 1'-0" (minimum).
        2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
        3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
        4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
        5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

E. General:

1. Provide coordination drawing files to the Architect/Engineer for review of identified conflicts. The Architect/Engineer will not act as the project coordinator and is not responsible for coordination of the work. The Architect/Engineer will review only clearly identified conflicts submitted by the Contractor and will not perform clash detection or coordination. The Architect/Engineer will not compile or reconcile multiple trade files and will rely on the Contractor's composite coordination drawing package.
2. The Contractor remains solely responsible for coordination regardless of any review or comment provided by the Architect/Engineer.
3. A plotted set of coordination drawings shall be available at the project site.
4. Coordination drawings are not shop drawings and are not subject to approval. Receipt or review of coordination drawings does not constitute approval of routing, layout, means, methods, sequencing, or constructability.

5. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
6. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
7. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
8. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
9. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
10. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
    b. Potential layout changes shall be made to avoid additional access panels.
    c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
    e. When additional access panels are required, they shall be provided without additional cost to the Owner.

11. Complete the coordination drawing process and obtain documented sign-off from all participating trades confirming that coordination drawings have been reviewed and coordinated prior to installation. Sign-off shall consist of signatures on the composite coordination drawing package or a coordination log identifying participating trades and acceptance of the coordinated layout.
12. Do not begin installation of work in an area until coordination drawings for that area are complete and trade sign-offs have been obtained.
13. Submit unresolved coordination conflicts to the Architect/Engineer for direction prior to installation. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination. Conflicts identified after installation due to incomplete coordination shall be corrected at no additional cost to the Owner.
14. Updated coordination drawings that reflect as-built conditions may be used as record documents.

## 1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the State of <NC> Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. Make application for and pay for service connections, such as gas.
4. Make application for and pay for all meters and metering systems required by the utility company.

F. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

    a. Any item listed as furnished shall also be installed, unless otherwise noted.
    b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD MEP.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

## 1.6 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. Air Cooled Condensers
2. Base Mounted Pumps
3. Boilers, Burners and Boiler Trim
4. Computer Room Units
5. Condensing Units
6. Fire Seal Systems
7. Vibration Isolation
8. Water Chillers

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.

## 1.7 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:

1. Motor windings and ventilation openings.
2. Bearings.
3. Equipment pipe and accessories connections openings. (e.g. boiler connections, coil connections, etc.)
4. Equipment duct and accessories connections openings. (e.g. AHU/RTU duct connections; terminal air boxes, etc.)
5. Starter and control cabinets.
6. Heat transfer coils.
7. Pump seals.
8. Combustion burner and blower equipment (e.g. combustion air intake, combustion vent/flue, etc.)

C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Owner that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.

D. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, they shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

## 1.8 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.9 WARRANTY

A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

C. 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.

1.10 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and 23 08 00 and provide all services as described in the Commissioning Plan.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

3.1 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.

D. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.

E. The instructions shall include:

1. Explanation of all system flow diagrams.
2. Explanation of all air handling systems.

3. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
4. Maintenance of equipment.
5. Smoke control systems.
6. Stairwell pressurization systems.
7. Start-up procedures for all major equipment.
8. Explanation of seasonal system changes.
9. Description of emergency system operation.

F. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.

G. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.

H. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.
2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

## 3.2 SYSTEM STARTING AND ADJUSTING

A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.

C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.

D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for troubleshooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

## 3.3 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.

D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

## 3.4 SPECIAL REQUIREMENTS

A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.

B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

## 3.5 MAINTAINING CLEAN DUCTWORK THROUGHOUT CONSTRUCTION

A. Throughout the duration of construction, all ductwork shall be capped or sealed with sheet metal caps, polyethylene film, or other airtight protective to keep dust, dirt, and construction debris out of ducts. Similar means shall be used to seal air-side connections of HVAC equipment to include, but not limited to, air handling units, fans, terminal air boxes, fan coil units, cabinet heaters, blower coils, and the like.

B. When air terminal devices are installed, contractors shall seal all supply, return, and exhaust grilles with polyethylene film or other airtight protective to keep dust, dirt, and construction debris out of ducts.

C. Should HVAC equipment be started during construction, Contractor shall remove airtight protectives and shall install one-inch thick MERV 8 filter media over all return and exhaust grilles to prevent dust, dirt, and construction debris from entering ductwork. Filter media shall cover the entire grille face and shall be secured such that air cannot bypass filter media.

D. Should filter media become laden with dust and dirt, Contractor shall replace filter media with new media to prevent damage to air distribution system and equipment.

E. The following steps shall be taken during testing, adjusting, and balancing of each air system:

1. All construction activities in all spaces served by the air system shall stop.
2. All airtight protectives and temporary filter media shall be removed from all portions of the air system.
3. Testing, adjusting, and balancing work shall not commence until all construction activity is stopped and all airtight protectives and temporary filter media is removed.
4. Once testing, adjusting, and balancing work is complete for the air system, airtight protectives or temporary filter media shall be installed over all ductwork openings and air terminals on the air system prior to resuming construction activities in any spaces served by the air system.

F. The Owner shall agree the building is sufficiently clean prior to the removal of any filtration media and airtight protectives from air terminal devices.

**END OF SECTION 230500**

## SECTION 23 05 03 - THROUGH PENETRATION FIRESTOPPING

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials

B. UL 723 - Surface Burning Characteristics of Building Materials

C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops

D. UL 2079 - Tests for Fire Resistance of Building Joint Systems

E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)

F. Intertek / Warnock Hersey - Directory of Listed Products

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops

I. The Building Officials and Code Administrators National Building Code

J. 1997 Uniform Building Code

K. 2018 International Building Code

L. NFPA 5000 - Building Construction Safety Code

1.4 SUBMITTALS

A. Submit under provisions of Division 1 .

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

## 1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.7 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

## PART 2 - PRODUCTS

2.1 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

| Penetrating Item | UL System No. |
|---|---|
| No Penetrating Item | FC 0000-0999* |
| Metallic Pipe or Conduit | FC 1000-1999 |
| Non-Metallic Pipe or Conduit | FC 2000-2999 |
| Electrical Cables | FC 3000-3999 |
| Cable Trays | FC 4000-4999 |
| Insulated Pipes | FC 5000-5999 |
| Bus Duct and Misc. Electrical | FC 6000-6999 |
| Duct without Damper and Misc. Mechanical | FC 7000-7999 |
| Multiple Penetrations | FC 8000-8999 |

*Alternate method of firestopping is patching opening to match original rated construction.

1. Non-Combustible Framed Walls - 1 or 2 Hour Rated:

   a. F Rating = Wall Rating

| Penetrating Item | UL System No. |
|---|---|
| No Penetrating Item | WL 0000-0999* |
| Metallic Pipe or Conduit | WL 1000-1999 |
| Non-Metallic Pipe or Conduit | WL 2000-2999 |
| Electrical Cables | WL 3000-3999 |
| Cable Trays | WL 4000-4999 |
| Insulated Pipes | WL 5000-5999 |
| Bus Duct and Misc. Electrical | WL 6000-6999 |
| Duct without Damper and Misc. Mechanical | WL 7000-7999 |
| Multiple Penetrations | WL 8000-8999 |

*Alternate method of firestopping is patching opening to match original rated construction.

2. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated:

   a. F Rating = Wall/Floor Rating

| Penetrating Item | UL System No. |
|---|---|
| No Penetrating Item | CAJ 0000-0999* |
| Metallic Pipe or Conduit | CAJ 1000-1999 |
| Non-Metallic Pipe or Conduit | CAJ 2000-2999 |
| Electrical Cables | CAJ 3000-3999 |
| Cable Trays | CAJ 4000-4999 |
| Insulated Pipes | CAJ 5000-5999 |
| Bus Duct and Misc. Electrical | CAJ 6000-6999 |
| Duct without Damper and Misc. Mechanical | CAJ 7000-7999 |
| Multiple Penetrations | CAJ 8000-8999 |

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

### 3.2 INSTALLATION

A. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

B. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

### 3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The Contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the Contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The Contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the Contractor's expense.

**END OF SECTION 230503**

## SECTION 23 05 13 - MOTORS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Phase and Three Phase Electric Motors.

1.2 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

E. ANSI/NEMA MG 1 - Motors and Generators.

F. ANSI/NFPA 70 - National Electrical Code.

G. Energy Independence and Security Act of 2007.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00. Include nominal efficiency and power factor for all premium efficiency motors. Efficiencies must meet or exceed the nominal energy efficiency levels presented below.

B. Submit shop drawings for all three phase motors.

C. Submit motor data with equipment when motor is installed by the manufacturer at the factory.

D. Submit shaft grounding rings or brushes for all motors as required.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

**PART 2 - PRODUCTS**

2.1 MOTORS - GENERAL CONSTRUCTION AND REQUIREMENTS

A. Refer to the drawings for required electrical characteristics. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

| Distribution/Nominal Voltage | Utilization Voltage |
|---|---|
| 120 | 115 |
| 208 | 200 |
| 240 | 230 |
| 277 | 265 |
| 480 | 460 |

B. Design motors for continuous operation in 40ºC environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.

D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

E. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.

F. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.

G. Each contractor shall set all motors furnished by him.

H. All motors shall have a minimum service factor of 1.15.

I. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.

J. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.

K. Aluminum end housings are not permitted on motors 15 HP or larger.

L. Motor Driven Equipment:

1. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.
2. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.

M. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide bases shall conform to NEMA standards.

N. Motors for fans and pumps 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 use sheave adjustments for airflow balancing in lieu of varying motor speed.

## 2.2 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Electronically Commutated Motors (ECMs) shall be motors in which rotation and speed are controlled by integral electronic motor controllers utilizing electronic commutation.

B. ECMs shall utilize Permanent Magnet (PM), Synchronous Reluctance (SynRM), or Ferrite-Assisted Synchronous Reluctance (FASR) motor constructions.

C. ECMs shall be AC-powered motors with internal electronic conversion of AC power to DC for motor control. Motor input power shall be AC, at the scheduled voltage and phase. Field wiring shall be AC. Internal conversion to DC for electronic commutation shall be provided by the motor manufacturer. Motor shall be pre-wired for scheduled voltage and phase.

D. Motors shall be variable-speed, suitable for continuous operation over the scheduled operating range, and matched by the manufacturer with an integral electronic motor control module.

E. Electronics shall be factory-mounted and factory-matched to the motor. Control electronics shall include soft-start functionality, electronic current limiting, and motor protection functions as recommended by the motor manufacturer. Electronics shall be protected against moisture and contaminants in accordance with the application and motor enclosure rating.

F. ECMs shall be suitable for direct-drive applications unless otherwise indicated. Motors shall be permanently lubricated and provided with ball bearings suitable for the connected driven equipment.

G. Motors shall be permanently lubricated; utilize ball bearings to match with the connected driven equipment.

H. Operational mode shall be as scheduled and shall be one of the following:

1. Constant Flow
2. Constant Temperature
3. Constant Pressure

## 2.3 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

A. All motors, unless exempted by EPAct legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

| | Full-Load Efficiencies % | | | | | |
|---|---|---|---|---|---|---|
| | Open Drip-Proof | | | Totally Enclosed Fan Cooled | | |
| HP | 1200 rpm | 1800 rpm | 3600 rpm | 1200 rpm | 1800 rpm | 3600 rpm |
| 1.0 | 82.5 | 85.5 | 77.0 | 82.5 | 85.5 | 77.0 |
| 1.5 | 86.5 | 86.5 | 84.0 | 87.5 | 86.5 | 84.0 |
| 2.0 | 87.5 | 86.5 | 85.5 | 88.5 | 86.5 | 85.5 |
| 3.0 | 88.5 | 89.5 | 85.5 | 89.5 | 89.5 | 86.5 |
| 5.0 | 89.5 | 89.5 | 86.5 | 89.5 | 89.5 | 88.5 |
| 7.5 | 90.2 | 91.0 | 88.5 | 91.0 | 91.7 | 89.5 |
| 10.0 | 91.7 | 91.7 | 89.5 | 91.0 | 91.7 | 90.2 |
| 15.0 | 91.7 | 93.0 | 90.2 | 91.7 | 92.4 | 91.0 |
| 20.0 | 92.4 | 93.0 | 91.0 | 91.7 | 93.0 | 91.0 |
| 25.0 | 93.0 | 93.6 | 91.7 | 93.0 | 93.6 | 91.7 |
| 30.0 | 93.6 | 94.1 | 91.7 | 93.0 | 93.6 | 91.7 |
| 40.0 | 94.1 | 94.1 | 92.4 | 94.1 | 94.1 | 92.4 |
| 50.0 | 94.1 | 94.5 | 93.0 | 94.1 | 94.5 | 93.0 |
| 60.0 | 94.5 | 95.0 | 93.6 | 94.5 | 95.0 | 93.6 |
| 75.0 | 94.5 | 95.0 | 93.6 | 94.5 | 95.4 | 93.6 |
| 100.0 | 95.0 | 95.4 | 93.6 | 95.0 | 95.4 | 94.1 |
| 125.0 | 95.0 | 95.4 | 94.1 | 95.0 | 95.4 | 95.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 150.0 | 95.4 | 95.8 | 94.1 | 95.8 | 95.8 | 95.0 |
| 200.0 | 95.4 | 95.8 | 95.0 | 95.8 | 96.2 | 95.4 |
| 250.0 | 95.4 | 95.8 | 95.0 | 95.8 | 96.2 | 95.8 |
| 300.0 | 95.4 | 95.8 | 95.4 | 95.8 | 96.2 | 95.8 |
| 350.0 | 95.4 | 95.8 | 95.4 | 95.8 | 96.2 | 95.8 |
| 400.0 | 95.8 | 95.8 | 95.8 | 95.8 | 96.2 | 95.8 |
| 450.0 | 96.2 | 96.2 | 95.8 | 95.8 | 96.2 | 95.8 |
| 500.0 | 96.2 | 96.2 | 95.8 | 95.8 | 96.2 | 95.8 |

B. Motor nameplate shall be noted with the above ratings.

2.4 MOTORS ON VARIABLE FREQUENCY DRIVES

A. All motors driven by VFDs shall be premium efficiency type.

B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors shall not be equipped with auxiliary blowers.

C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, "Performance Standards Applying to All Machines," Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors.

D. All 480 volt motors driven by VFDs shall be provided with shaft grounding rings or grounding brushes as a means to protect bearings from adverse shaft currents.

1. Providing grounding rings internal to the motor housing is an acceptable solution, provided the motor is affixed with a label clearly indicating the presence of a grounding assembly. The grounding ring shall be listed for 40,000 hours of motor service and shall be accessible via the drive endplate.
2. Motor shafts 2" and larger require shaft grounding on the drive end and the non-drive end. This Contractor shall ensure (via field observation and measurement) that the shaft is effectively grounded upon startup.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.

C. For belt drive motors, mount sheaves on the appropriate shafts per manufacturer's instructions. Use a straight edge to check alignment of the sheaves. Reposition sheaves as necessary so the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so the belt(s) can be added, and tighten the base so the belt tension is in accordance with the drive manufacturer's recommendations. Frequently check belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

**END OF SECTION 230513**

## SECTION 230515 – VARIABLE FREQUENCY DRIVES

## PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes variable-frequency AC drives (VFDs).

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500, Common Work Results for HVAC

B. Section 230900, Instrumentation and Controls for HVAC

C. Division 26, Electrical

1.3 REFERENCES

A. IEEE: Institute of Electrical and Electronics Engineers

1. IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

B. NEC: National Electrical Code

C. NEMA: National Electrical Manufacturers Association

1.4 SUBMITTALS

A. For systems, equipment, and components specified herein, submit product/material data; shop drawings; operation and maintenance data; as-constructed data; installation, startup, and testing manuals; operation and maintenance manuals; and as-constructed drawings.

1. Product Data: Include dimensions, weight, schematic and single-line diagram, total harmonic distortion (THD), standard functions, features, capacities, and details of construction.

1.5 WARRANTY

A. VFDs shall have a minimum warranty of 12 months from the date of certified startup and not less than 18 months from date of manufacture. The warranty shall include all parts, labor, travel time, and expenses.

B. The Contractor shall coordinate with the VFD manufacturer and be responsible for the VFD warranty and all VFD problems incurred during and after installation at the work site, as well as

provide and warranty any individual VFD units sent to the manufacturer for required equipment run testing. Supply technical assistance during testing at the manufacturer's factory, coordinate shipping, and pay for all costs.

## PART 2 - PRODUCTS

### 2.1 VARIABLE-FREQUENCY MOTOR CONTROLLERS

A. Acceptable Manufacturers: ABB, Danfoss or Trane

B. General Description:

1. AC motor variable frequency controller (VFC) shall be of pulse width modulated (PWM) inverter type. The VFC shall be designed to convert 60 Hz input power to adjustable frequency output power to provide positive speed control to standard induction motors. The VFC shall be dedicated variable torque design for specific use with centrifugal loads.
2. Provide complete solid state variable frequency power and logic unit.
3. Frequency control shall be stepless throughout the range under variable torque load on a continuous basis. Frequency controlled by remote building energy management system providing 4-20MA input signal to drive and remote start/stop signal. Coordinate with other work of Division 23.
4. Provide adjustable frequency control with diode bridge/capacity input designed to provide high, constant power factor of 0.95 regardless of load or speed and eliminate SCR line noise.
5. Each VFD shall contribute no more than 5 percent total harmonic voltage distortion at the VFD input terminals while operating under full-load conditions. If proposed VFD equipment is anticipated to exceed these limits, multi-pulse converters and/or harmonic filtering devices shall be provided.
6. Design and manufacture equipment in accordance with applicable NEMA and IEEE recommendations and be designed for installation in accordance with NEC. Equipment shall have UL and/or CSA approval.
7. Control shall be suitable for operation in ambient temperatures of 0 to 40ºC.
8. Every VFD shall be factory tested with an AC induction motor 100 percent loaded and temperature cycled within an environmental chamber at 104ºF.

C. Self-Protection and Reliability Features:

1. Adjustable current limit from 60 to 110 percent of drive rating.
2. Adjustable instantaneous over current trip.
3. Under voltage trip.
4. Over temperature trip.
5. Short circuit protection phase to phase and phase to ground faults phase rotation insensitive.
6. Momentary power loss, more than 17 milliseconds.
7. Transient protection against all normal transients and surges in incoming power line.
8. Orderly shutdown in event of any of above conditions, drive shall be designed to shut down safely without component failure.
9. Provide visual indication and manual reset.

D. Standard Features:

1. Drive logic shall be microprocessor based. Control logic shall be isolated from power circuitry.
2. Standalone operation to facilitate startup and troubleshooting procedures.
3. VFD shall have a lockable circuit breaker disconnect and be UL 508C listed for use on distribution systems with 22,000 AIC.
4. Door interlock protection which shall be defeatable by qualified personnel to troubleshoot during operation as required.
5. Input power shall be equal to applied input voltage.
6. Isolated signal inputs.
7. Frequency Stability: Output frequency shall be held to +0.1 percent of maximum frequency regardless of load, +10 percent input voltage change or temperature changes within ambient specification.
8. Built-in digital display located in panel face shall indicate output frequency, voltage and current and shall provide indication of over current, over voltage, current limit, ground fault, over temperature, input power on, minimum or maximum speed adjustment, power on, and fault condition.
9. Start/Stop Control: Controlled decelerated stop.
10. Primary and secondary fused for a control circuit transformer.
11. Minimum and maximum speed control.
12. Adjustable Accel/Decel: Independently adjustable 10-100 second.
13. Hands-off auto switches.
14. Programmable auto restart after power outage.
15. Fused disconnects shall include auxiliary contacts to isolate control circuit when disconnect is in “off” position.
16. Remote contacts for fault, and on/off status.
17. Adjustable motor output voltage.
18. Analog output voltage of 0-10 VDC, 4-20MA proportional to control output frequency.
19. Communications port, and programming software capability for BACnet-IP

E. Additional Features:

1. NEMA 1 enclosure shall isolate each motor starter and control section with its associated disconnect switch.
2. Manual speed control for each motor.
3. Manual bypass shall provide ability to service control while motor is operational.
4. Provide radio frequency and electromagnetic interference noise suppression network to limit radio frequency and electromagnetic interference.
5. Provide isolated analog output signals for volts, amps, and frequency, from each VFD for connection to the building energy management system.
6. Provide line (input) reactors.
7. Provide output filters for all VFD’s located more than 150 conductor feet from the motor they serve.
8. VFD shall be designed to catch a spinning load in forward and reverse direction.
9. Perform harmonic calculations on a manufacturer-supplied harmonic analysis program for conformance with IEEE 519.

F. CSA, ETL, or UL label.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Coordinate with the VFD manufacturer to provide and be responsible for all coordination, application engineering, and startup support to ensure that the VFD is properly selected for each piece of equipment.

### 3.2 VARIABLE SPEED CONTROLLER INSTALLATION

A. Mount on walls in accordance with the manufacturer's instructions.

B. Coordinate input/output power connections with Division 26.

C. Coordinate control signal with other work of Division 23.

D. Provide startup service by factory authorized technician.

### 3.3 TESTING

A. Check out, start up, and test systems, equipment, and components specified herein.

B. The owner reserves the right to witness any or all of the aforementioned tests. Provide notice at least 24 hours before testing.

C. Provide, at no additional cost to the owner, any technical assistance or support to ensure the proper testing/performance of the VFD and of the system as a whole. This includes programming of the VFD to coordinate with the manufacturer's operating requirements. Allow 2 hours of startup time per VFD.

D. Provide complete programming information for startup for each VFD. Provide these parameters in writing to the owner prior to the startup of the VFD and cover the protection, ramp up, ramp down, carrier frequency, and all other necessary parameters.

**END OF SECTION 230515**

## SECTION 23 05 29 - HVAC SUPPORTS AND ANCHORS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.

B. Equipment Bases and Supports.

C. Sleeves and Seals.

D. Flashing and Sealing of Equipment and Pipe Stacks.

E. Cutting of Openings.

F. Escutcheon Plates and Trim.

1.2 REFERENCES

A. ANSI/ASME B31.9 - Building Services Piping.

B. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

C. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

D. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

E. MSS SP-127 - Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00. Include plastic pipe manufacturers' support spacing requirements.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

## PART 2 - PRODUCTS

### 2.1 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:
   1. Steel Pipe:
      a. Hanger Rod Diameter:
         1) 2" and smaller: 3/8"
         2) 2-1/2" through 3-5/8": 1/2"
         3) 4" through 6": 1/2"
         4) 8": 5/8"
   2. Copper, Plastic and Fiberglass Reinforced Pipe:
      a. Hanger Rod Diameter:
         1) 2" and smaller: 3/8"
         2) 2-1/2" through 3-5/8": 1/2"
         3) 4") through 6": 1/2"
         4) 8": 5/8"

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

### 2.2 PIPE AND STRUCTURAL SUPPORTS

A. General:
   1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).
   2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

2. Cold Pipe: Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.
3. Cold Pipe Alternative: Insulated pipe riser clamp with no thermal bridging between clamp and pipe; water repellant calcium silicate insulation material adhered inside the clamp; ASTM A653 galvanized steel clamp.
4. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp within their temperature limits of -65F to +225F.
3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
4. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.

5. Unless otherwise indicated, hangers shall be as follows:

    a. Clevis Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and Smaller:

        1) Products: Bare Steel, Plastic or Insulated Pipe:

            a) Anvil Fig. 260
            b) Eaton Fig. 3100
            c) Roller Type: Service: Insulated Hot Pipe - 4 inches and Larger:

        2) Products: 4" through 6":

            a) Anvil Fig. 181, 271

b) Eaton Fig. 3110
c) nVent Model 610

3) Products: 8" and Above:

a) Anvil Fig. 171, 271
b) Eaton Fig. 3114, 3117
c) nVent Model 605

b. Adjustable Swivel Ring Type: Service: Bare Metal Pipe - 4 inches and Smaller:

1) Products: Bare Steel Pipe:

a) Anvil Fig. 69
b) Eaton Fig. B3170NF
c) nVent Model 115

2) Products: Bare Copper Pipe:

a) Eaton Fig. B3170CTC
b) nVent 102A0 Series
c) Anvil Fig. CT-69

6. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

7. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

a. Clamp Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller:

1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp.
2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
3) Products: Bare Steel, Plastic or Insulated Pipe:

a) Unistrut Fig. P1100 or P2500
b) Eaton Fig. B2000 or B2400
c) Anvil Fig. AS1200

d) nVent USC

4) Products: Bare Copper Pipe:

a) Eaton Fig. BVT
b) nVent CADDY Cushion Clamp

b. Roller Type: Service: Insulated Hot Pipe - 4 inches and larger:

1) Products: 4" through 6":

a) Unistrut Fig. P2474
b) Eaton Fig. B218
c) Anvil Fig. ROL-12
d) nVent ROL12

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):

1) Products:

a) Anvil Fig. 86
b) Eaton Fig. B3033/B3034
c) nVent Model 300 & 310

b. Scissor Type Beam Clamps (for use with bar-joists and wide flange):

1) Products:

a) Anvil Fig. 228, 292
b) Eaton Fig. B3054
c) nVent Model 360

c. Concentrically Loaded Open Web Joist Hangers (for use with bar joists):

1) Products:

a) MCL. M1, M2 or M3

d. Concrete: Inserts Single Rod Galvanized:

1) Products:

a) Anvil Fig. 282
b) Eaton Fig. B3014
c) nVent Model 355

e. Concrete: Inserts Continuous Strip Galvanized:

1) Products:

a) Unistrut Corp P3200 Series
b) Eaton Fig. B22
c) nVent CONB
d) Anvil AS249

f. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-17. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

g. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

h. Steel Structure Welding:

1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

## 2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 6 inches on all sides of the equipment (6 inches larger than factory base), except where pad extension would interfere with working space at equipment control panels and electrical panels.
2. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".
3. Concrete materials and workmanship required for the Contractor's work shall be provided by the Contractor. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6"x6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days (be 20 MPa strength). Provide minimum 1/2" 45 degree angled or 1/2" radius chamfer on exposed horizontal edges.

4. Equipment requiring bases is as follows:

    a. Air Compressor
    b. Air Handling Unit
    c. Boiler
    d. Chemical Feed Equipment
    e. Chiller
    f. Expansion Tank
    g. Fans
    h. Pump
    i. Tank

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

## 2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

F. Exposed Housing Penetrations: Seal pipes with surface temperature below 150F, penetrating housings with conical stepped, white silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite.

## 2.5 SLEEVES AND LINTELS

A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

J. Wall Seals ("Link-Seals"):

1. Underground foundation wall penetrations and where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.

2. Sleeves, if used, shall be at least 2 pipe sizes larger than the service pipe and shall include a waterstop/anchor around the mid section of the sleeve, continuously welded to or integral formed with the sleeve. Sleeve material options based on fluid carrying pipe design temperature.
3. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.
4. Sealing element shall be as follows:

| Model | Service | Element Material | Temperature Range |
|---|---|---|---|
| S | Standard (Stainless) | EPDM | -40F to 250F |
| T | Fire Seals (1 hour) | Silicone | -67F to 400F |
| FS | Fire Seals (3 hours) | Silicone | -67F to 400F |
| OS | Oil Resistant/Stainless | Nitrile | -40F to 210F |

## 2.6 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

## 2.7 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

## 2.8 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.9 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

## PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.
2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with Sheet Metal Contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
2. Set all concrete inserts in place before pouring concrete.
3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. For attachments to joists that are concentrically loaded on the joist, a max of 100 lbs may be attached to the joist within a chord panel.
2. For attachments to joists that are eccentrically loaded, a max of 25 lbs may be attached to the joist within a chord panel without an additional angle.
3. Multiple attachments are allowed in each chord panel as long as the sum of the loads do not exceed the max load indicated.
4. For loads between 100 lbs - 200 lbs, additional L2x2x3/16" (L51xL51x4.8) ASTM A36 structural steel angles are required and joist must be concentrically loaded.
5. For loading conditions noted above, total sum of loads shall not exceed 200 lbs for an 8 ft segment for joist. For loads greater than 200 lbs and not noted on the drawings, contact engineer prior to installation.
6. No loads shall be supported from joist bridging.
7. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
8. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):

a. Maximum Spacing:

1) 1-1/4" & under: 7'-0"
2) 1-1/2": 9'-0"
3) 2": 10'-0"
4) 2-1/2": 11'-0"

5) 3": 12'-0"
6) 4" & larger: 12'-0"

2. Steel (Std. Weight or Heavier - Vapor Service):

a. Maximum Spacing:

1) 1-1/4" and under: 9'-0"
2) 1-1/2": 12'-0"
3) 2" & larger: 12'-0"

3. Hard Drawn Copper & Brass (Liquid Service):

a. Maximum Spacing:

1) 3/4" and under: 5'-0"
2) 1": 6'-0"
3) 1-1/4": 7'-0"
4) 1-1/2" 8'-0"
5) 2": 8'-0"
6) 2-1/2": 9'-0"
7) 3": 10'-0"
8) 4": 12'-0"
9) 6": 12'-0"

4. Hard Drawn Copper & Brass (Vapor Service):

a. Maximum Spacing:

1) 3/4" & under: 7'-0"
2) 1": 8'-0"
3) 1-1/4": 9'-0"
4) 1-1/2": 10'-0"
5) 2": 11'-0"
6) 2-1/2" & larger: 12'-0"

5. Plastic Pipe:

a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.

I. Installation of hangers shall conform to MSS SP-58, 69, and 89.

**END OF SECTION 230529**

## SECTION 23 05 48 - HVAC VIBRATION ISOLATION

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bases.

B. Vibration Isolation.

C. Flexible Connectors.

1.2 SUBMITTALS

A. Submit shop drawings per Section 23 05 00 and the Vibration Isolation Submittal Form at the end of this section.

B. Vibration isolation submittals may be included with equipment being isolated, but must comply with this section.

C. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.

D. Isolator submittals shall include:

1. Equipment served
2. Type of Isolator
3. Load in Pounds per Isolator
4. Recommended Maximum Load for Isolator
5. Spring Constants of Isolators (for Spring Isolators)
6. Load vs. Deflection Curves (for Neoprene Isolators)
7. Specified Deflection
8. Deflection to Solid (at least 150% of calculated deflection)
9. Loaded (Operating) Deflection
10. Free Height
11. Loaded Height
12. Kx/Ky (horizontal to vertical stiffness ratio - for spring isolators)
13. Materials and Coatings
14. Spring Diameters

E. Make separate calculations for each isolator on equipment where the load is not equally distributed.

F. Flexible connector shop drawings shall include overall face-to-face length and all specified properties.

1.3 EQUIPMENT SUPPLIERS' INSPECTION

A. The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Engineer and Owner which verifies that all of the M2-M4 mountings and H1-H3 hangers have been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection, and measured static deflection of the isolators provided.

**PART 2 - PRODUCTS**

2.1 BASIC CONSTRUCTION AND REQUIREMENT

A. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.

B. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection (e.g., 3" for 2" calculated deflection). The point of 50% additional deflection shall not exceed the recommended load rating of the isolator.

C. The lateral to vertical stiffness ratio (Kx/Ky) of spring isolators shall be between 0.8 and 2.0.

D. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.

E. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.

F. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.

G. Provide motor slide rails for belt-driven equipment per Section 23 05 13.

H. All isolators, except M1, shall have provision for leveling.

2.2 MOUNTINGS

A. Type M1:

1. 0.75" thick waffled neoprene pad with minimum static deflection of 0.07" at calculated load and 0.11" at maximum load. For loads less than 15 pounds, the deflection at calculated load requirement is waived, but the isolator must have a maximum stiffness of the ratio of 45#/0.35".
2. Units need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators.
3. Manufacturers:

    a. Mason "Super W"
    b. Kinetics "NGS"
    c. VMC/Amber-Booth "SPNR"
    d. Vibration Eliminator Co. "400N"

B. Type M2:

1. Double deflection neoprene with minimum static deflection of 0.15" at calculated load and 0.35" at maximum rated load.
    a. All metal shall be neoprene covered. Mounting shall have friction pads both top and bottom.

2. All units shall have bolt holes and be bolted down.
3. Use steel rails above the mountings to compensate for the overhang of equipment such as small vent sets and close coupled pumps.
4. Manufacturers:

    a. Mason Industries "ND" or "DNR"
    b. VMC/Amber-Booth "RVD"
    c. Kinetics "RD"
    d. Vibration Mountings and Controls "RD"
    e. Vibration Eliminator Co. "T22" or "T44"

C. Type M3:

1. Free standing, laterally stable spring isolators without housings and complete with 1/4" neoprene friction pads.
2. Units shall have bolt holes but need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators. Bolt holes shall not be within the springs.
3. All mountings shall have leveling bolts.
4. Manufacturers:

    a. Mason "SLFH"
    b. Kinetics "FDS"
    c. VMC/Amber-Booth SW-3 [4"][, 5"][, or][ 6"]
    d. Vibration Eliminator Co. "OST"

D. Type M4:

1. Use restrained spring mountings for equipment with operating weight different from the installed weight such as chillers and boilers, and equipment exposed to the wind such as cooling towers.
2. Spring isolators shall be free-standing with 1/4" neoprene acoustical friction pads.
3. All units shall have bolt holes and be bolted down. Prevent short circuiting with neoprene bushings and washers between bolts and isolators.
4. All mountings shall have leveling bolts.
5. Housings with vertical resilient limit stops shall prevent spring extension when weight is removed. Housings shall serve as blocking during erection and the installed and operating heights shall be the same.
6. Maintain a minimum clearance of 1/2" around restraining bolts and between the housings and the springs so as not to interfere with the spring action.
7. Limit stops shall be out of contact during normal operation.
8. Select isolators for equipment subjected to wind loads in conformance with ASCE 7-02.

## 2.3 HANGERS

A. Type H1:

1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.
2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.
3. Provide hangers with end connections as required for hanging ductwork or piping.
4. Manufacturers:

    a. Mason "HD"
    b. Kinetics "RH"
    c. Aeroflex "RHD"
    d. Vibration Eliminator Co. "IC/3C/3CTD"
    e. Vibro Acoustics "RH"

## 2.4 FLEXIBLE CONNECTORS (NOISE AND VIBRATION ELIMINATORS)

A. Type FC1:

1. Spherical flexible connectors with multiple plies of nylon tire cord fabric and either EPDM or molded and cured neoprene. Outdoor units shall be EPDM.
2. Steel aircraft cables or threaded steel rods shall be used to prevent excess elongation.
3. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer.
4. Connectors up to 2" size may have threaded ends.
5. Connectors 2-1/2" and over shall have floating steel flanges recessed to lock raised face neoprene flanges.
6. All connectors shall be rated for a minimum working pressure of 150 psi at 200F.

7. Manufacturer:

    a. Metraflex "Double Cable-Sphere"
    b. Minnesota Flex Corp.
    c. Mercer "450 Series"
    d. Twin City Hose "MS2".

B. Type FC2:

1. Stainless steel flexible connectors with corrugated stainless steel hose body and stainless steel braided casing.
2. Rated for minimum working pressures of 150 psi at 70F and 100 psi at 800F.
3. Sizes 2" and under shall have steel threaded connections.
4. Sizes 2-1/2" and over shall have 150 lb. steel flanges.
5. Suitable for 1/2" permanent misalignment.
6. Manufacturers:

    a. Mason or Mercer "BSS-GU"
    b. Metraflex "ML"
    c. Twin City Hose "TCHS"
    d. American "BOA B4-1"
    e. Flexible Metal Hose Company "FM-21"
    f. or Wheatley.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Provide vibration isolation as indicated on the drawings and as described herein.

C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from baseplates with neoprene washers and bushings.

D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.

E. Support equipment to be mounted on structural steel frames with isolators under the frames or under brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.

F. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

## 3.2 PIPE ISOLATION

A. The first three hangers from vibration-isolated equipment shall be type H1.

B. For base mounted pumps without resilient mountings, the first five hangers shall be Type H1.

C. Where piping is floor-supported, use M2 instead of H1 and M3 instead of H2.

D. Install flexible connectors in all piping connected to vibration producing equipment. This includes all fans, base-mounted pumps, compressors, etc. Absence of flexible connectors on piping diagrams does not imply that they are not required.

E. Use Type FC1 where pressures are lower than 150 psi, temperatures are below 220F, and the fluid handled is compatible with neoprene and EPDM.

F. Use Type FC2 for all other services. FC2 shall be installed parallel with equipment shafts.

G. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.

H. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the isolators until the installation is complete and under full operational load. Hanger H3 and Mounting M4 may be used instead of other products for this purpose.

I. Support piping to prevent extension of flexible connectors.

## 3.3 VIBRATION ISOLATION OF DUCTWORK

A. The first three hangers on all fan systems shall be Type H1 with at least 0.20" minimum static deflection.

B. Provide flexible duct connections as described in Section 23 33 00 at all fan inlets and outlets and on the mechanical room side of all locations where ducts penetrate mechanical room walls.

## 3.4 VIBRATION ISOLATION SCHEDULE

A. Inline Pumps:

1. Base Type: NA
2. Isolator Type: M3 or H2 or H3
3. Static Deflection :0.75"
4. Flexible Connections: NA

B. Base-Mounted Pumps:

1. Base Type: NA
2. Isolator Type: NA
3. Static Deflection: NA
4. Flexible Connections: FC-1

C. Air Cooled Chillers (mounted on grade):

1. Base Type: NA
2. Isolator Type: NA
3. Static Deflection: NA
4. Flexible Connections: FC-1

D. Boilers:

1. Base Type: NA
2. Isolator Type: NA
3. Static Deflection: NA
4. Flexible Connections: FC-1

E. AHU Fans:

1. Isolator Type: M3 and/or TR1
2. Static Deflection: Refer to ASHRAE Table
3. Flexible Connections: Per Section 23 33 00

**END OF SECTION 230548**

**THIS PAGE INTENTIONALLY LEFT BLANK**

## SECTION 23 05 53 - HVAC IDENTIFICATION

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 23.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

B. ASTM B-1, B-3, and B-8 for copper conductors.

C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 - 2kV Cables.

D. CGA Pamphlet C-9, Standard Color-Marking of Compressed Gas Cylinders for Medical Use.

E. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
2. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
3. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
4. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

B. Pipe Markers:

1. All pipe markers shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

| OD of Pipe or Insulation | Marker Length | Size of Letters |
|---|---|---|
| Up to and including 1-1/4" | 8" | 1/2" |
| 1-1/2" to 2" | 8" | 3/4" |
| 2-1/2" to 6" | 12" | 1-1/4" |
| 8" to 10" | 24" | 2-1/2" |
| Over 10" | 32" | 3-1/2" |

Plastic tags may be used for outside diameters under 3/4"

2. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
3. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.
4. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.
5. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.
6. Tracer Wire:

    a. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.
    b. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.
    c. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

C. Ductwork Markers:

1. Ductwork systems shall be provided with preprinted, color-coded lettering indicating service, equipment serving, and arrow showing flow direction. Refer to Part 3 for installation information.
2. Self-Adhesive Vinyl Duct Labels: Colored vinyl with permanent Contact-type permanent pressure-sensitive adhesive backing suitable for indoor and outdoor application compatible with label and with substrate. Stencil painted markers are not permitted on ductwork systems.
3. Maximum Temperature: Able to withstand temperatures up to 160F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 inch by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and 1-1/2 inches high beyond 72 inches viewing distance. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

6. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

D. Ceiling Markers:

1. Label Style:

a. The intent is for the ceiling labels to be inconspicuous but easy to find and read while standing underneath. The labels shall be located on the grid T-bar nearest the ceiling tile that can be removed to provide the best access to the serviceable side of equipment or to valves. An arrow can be used to point to the tile needing removal.
b. The label tape shall be approximately 1/2" wide with all capitalized letters approximately 3/16” tall.
c. Ceiling grid labels shall be made with a label maker with durable adhesive labels having a clear background and black letters.
d. Equipment labels shall be as designated on the drawings (e.g., FCU-606B, etc.).
e. Valve labels shall be designated by the size, service, and the valve tag number (e.g., 1-1/4" CW #123, 2" HWS #234, etc.). A single longer label can be used to identify multiple valves using spaces between the descriptors if the valves are located close together and have the same service (e.g., HWS and HWR valves serving the same equipment or CW, HW, and HWC lines serving the same restroom, etc.).
f. Fire, fire/smoke and smoke dampers shall be labeled consistent with the type (e.g., Fire Damper, Fire/Smoke Damper, etc.).

2. "Dot" Style:

a. The intent is for the ceiling labels to be inconspicuous but easy to find and read while standing underneath. The labels shall be located on the grid T-bar nearest the ceiling tile that can be removed to provide the best access to the serviceable side of equipment or to valves.

b. The marker shall be a self-adhesive color dot approximately 1/2" in diameter.

c. The equipment and accessories to be marked and dot color shall be coordinated with the Architect/Engineer and Owner.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.
2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
3. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
4. Attach to handwheel or around valve stem.
5. Number all tags and show the service of the pipe.
6. Provide one Plexiglas framed valve directory listing all valves, with respective tag numbers, uses and locations. Mount directory in location chosen by the Architect/Engineer.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
3. Stencil Painted Pipe Markers:

    a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
    b. Apply primer on non-insulated pipes before painting.
    c. Use background and letter colors as scheduled later in this section.

4. Apply markers and arrows in the following locations where clearly visible:

    a. At each valve.
    b. On both sides of walls that pipes penetrate.
    c. At least every 20 feet along all pipes.
    d. On each riser and each leg of each "T" joint.
    e. At least once in every room and each story traversed.

5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Ductwork Markers:

1. Apply ductwork markers on ductwork systems in the following locations where clearly visible:

    a. On both sides of walls that ducts penetrate.
    b. At least every 20 feet along all ducts.
    c. On each riser and each leg of each branch connection.
    d. At least once in every room and each story traversed.
    e. At all ductwork access doors.

f. At all fans and equipment serving ductwork system. Markers shall be clearly visible from the normal maintenance access path to the equipment. Coordinate placement location with Owner.

F. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

G. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.
2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.

H. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.
2. Tracer wire shall be taped directly to plastic water or drain pipe.
3. Tracer wire shall not be fastened directly or indirectly to gas piping.
4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.
5. Tape shall be Polyken "930-35", Protecto-Wrap "310", or approved equal.
6. Tracer wire shall be continuous between boxes and shall be tested for continuity.
7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. Wire nuts shall not be used.
8. The tracer wire shall daylight to grade through a 2" PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

## 3.2 SCHEDULE

A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:

1. HEATING WATER SUPPLY: White lettering; green background
2. HEATING WATER RETURN: White lettering; green background
3. CHILLED WATER SUPPLY: White lettering; green background
4. CHILLED WATER RETURN: White lettering; green background

5. CONDENSATE DRAIN: White lettering; green background
6. NATURAL GAS: Black lettering; yellow background
7. REFRIGERANT LIQUID: White lettering; purple background
8. REFRIGERANT SUCTION: White lettering; purple background
9. Underground Piping: Varies
10. Tracer Wire - Natural Gas Pipe Lines: Black lettering; yellow background
11. Tracer Wire - All other buried types: White lettering; green background

B. Ductwork and Fan Systems: All fans, filters housings, and access doors shall be labeled with text as follows:

1. SUPPLY AIR: White lettering; green background
2. RETURN AIR: White lettering; green background
3. GENERAL EXHAUST AIR: Black lettering; yellow background
4. VENTILATION AIR: White lettering; green background
5. RELIEF Black lettering; yellow background

**END OF SECTION 230553**

## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjusting, and balancing of air systems.

B. Testing, adjusting, and balancing of heating systems.

C. Testing, adjusting, and balancing of cooling systems.

D. Measurement of final operating condition of HVAC systems.

1.2 QUALITY ASSURANCE

A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, or TABB Certified Supervisor.

B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance, Seventh Edition.

B. ADC - Test Code for Grilles, Registers, and Diffusers.

C. AMCA - Publication 203-90; Field Performance Measurement of Fan Systems.

D. ASHRAE - 2019 HVAC Applications Handbook; Chapter 39, Testing, Adjusting and Balancing.

E. ASHRAE/ANSI - Standard 111-2008; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.

F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Ninth Edition, 2019.

G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing (latest edition).

H. TABB - International Standards for Environmental Systems Balance.

## 1.4 SUBMITTALS

A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.

B. Electronic Copies:

1. Submit a certified copy of test reports to the Architect/Engineer for approval. Electronic copies shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Copies that are not legible will be returned to the Contractor for resubmittal. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
2. Electronic file size shall be limited to a maximum of 10MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
3. All text shall be searchable.
4. Bookmarks shall be used. All bookmark titles shall be an active link to the index page and index tabs.

## 1.5 REPORT FORMS

A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.

B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.

C. Refer to PART 4 for required reports.

## 1.6 WARRANTY/GUARANTEE

A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.

B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

## 1.7 SCHEDULING

A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.

B. Project will be constructed in phases. Provide balancing report after each phase is complete.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS

A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.

B. The Balancing Contractor shall incorporate all pertinent documented construction changes (e.g. submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.

C. Recorded data shall represent actual measured or observed conditions.

D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.

E. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.

G. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to match. Refer to Section 23 09 00 for additional information.

H. Installations with systems consisting of multiple components shall be balanced with all system components operating.

### 3.2 EXAMINATION

A. Before beginning work, verify that systems are complete and operable. Ensure the following:

1. General Equipment Requirements:

    a. Equipment is safe to operate and in normal condition.
    b. Equipment with moving parts is properly lubricated.

c. Temperature control systems are complete and operable.
d. Proper thermal overload protection is in place for electrical equipment.
e. Direction of rotation of all fans and pumps is correct.
f. Access doors are closed and end caps are in place.

2. Duct System Requirements:

a. All filters are clean and in place. If required, install temporary media.
b. Duct systems are clean and free of debris.
c. Fire/smoke and manual volume dampers are in place, functional and open.
d. Air outlets are installed and connected.
e. Duct system leakage has been minimized.

3. Pipe System Requirements:

a. Coil fins have been cleaned and combed.
b. Hydronic systems have been cleaned, filled, and vented.
c. Strainer screens are clean and in place.
d. Shutoff, throttling and balancing valves are open.

B. Report any defects or deficiencies to Architect/Engineer.

C. Promptly report items that are abnormal or prevent proper balancing.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

## 3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.

B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

## 3.4 INSTALLATION TOLERANCES

A. ± 10% of scheduled values:

1. Adjust air inlets and outlets to ± 10% of scheduled values.
2. Adjust piping systems to ± 10% of design values.

B. ± 5% of scheduled values

1. Adjust outdoor air intakes to within + 5% of scheduled values.

C. Adjust supply, return, and exhaust air-handling systems to +10% / -5% of scheduled values.

## 3.5 ADJUSTING

A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.

B. Once balancing of systems is complete, at least one damper or valve must be 100% open.

C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.

D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.

E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

## 3.6 SYSTEM PERFORMANCE REPORT

A. After the conclusion of balancing operations, utilize the building DDC system or install portable data loggers to simultaneously record temperatures and humidity during summer and winter conditions for a seven-day period, continuous over a weekend, and including at least one period of operation at outside conditions within 5F wet bulb temperature of maximum summer design condition and within 10F dry bulb temperature of minimum winter design condition.

B. Architect/Engineer will direct all test locations.

C. Report of test results shall include original recording and three reproductions.

## 3.7 SUBMISSION OF REPORTS

A. Fill in test results on appropriate forms.

# PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

## 4.1 GENERAL REQUIREMENTS

A. Title Page:

1. Project name.
2. Project location.
3. Project Architect.
4. Project Engineer (IMEG Corp.).
5. Project General Contractor.
6. TAB Company name, address, phone number.
7. TAB Supervisor's name and certification number.

8. TAB Supervisor's signature and date.
9. Report date.

B. Report Index

C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

## 4.2 AIR SYSTEMS

A. Duct Leakage Test:

1. Air system and fan.
2. Leakage class.
3. Test pressure.
4. Construction pressure.
5. Flow rate (cfm): specified and actual.
6. Leakage (refer to Section 23 31 00 in the specifications): specified and actual.
7. Statement that fire dampers, reheat coils and other accessories were included in the test.
8. Pass or Fail.
9. Test performed by.
10. Test witnessed by.

B. Air Moving Equipment:

1. General Requirements:

a. Drawing symbol.
b. Location.
c. Manufacturer, model, arrangement, class, discharge.
d. Fan RPM.
e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
f. Final frequency of motor at maximum flow rate (on fans driven by VFD).

2. Flow Rate:

a. Supply flow rate (cfm): specified and actual.
b. Return flow rate (cfm): specified and actual.
c. Outside flow rate (cfm): specified and actual.
d. Exhaust flow rate (cfm): specified and actual.

3. Pressure Drop and Pressure:

a. Filter pressure drop: specified and actual.
b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
c. Inlet pressure.
d. Discharge pressure.

C. Fan Data:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Total static pressure: specified and actual. (Indicate measurement locations).
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

D. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

E. Duct Traverse:

1. System zone/branch/location.
2. Duct size.
3. Free area.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Duct static pressure.
7. Air temperature.
8. Air correction factor.

F. Air Terminal (Inlet or Outlet):

1. Drawing symbol.
2. Room number/location.
3. Terminal type and size.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Percent of design flow rate.

G. Air Terminal Unit (Terminal Air Box) Data:

1. General Requirements:

    a. Drawing symbol.
    b. Location.
    c. Manufacturer and model.
    d. Size.
    e. Type: constant, variable, single, dual duct.

2. Flow Rate:

    a. Cooling maximum flow rate (cfm): specified and actual.
    b. Heating maximum flow rate (cfm): specified and actual.
    c. Minimum flow rate (cfm): specified and actual.
    d. Water flow rate (gpm): specified and actual with system performance adjusted as follows:

        1) Adjust heating water system pump to maintain maximum system differential pressure.
        2) Set calibrated balance valve fully open.
        3) Command terminal air box control valve to fully open.
        4) Measure heating coil flow using calibrated balance valve.
        5) Note: Commanding terminal air box control valve to be fully open shall be done on a valve-by-valve basis. Do not command all control valves to be fully open at the same time, as the heating water system may not have sufficient capacity.
        6) Note: After Balancing of all terminal air boxes is complete, release the heating water pump to automatically reset the system DP based on control valve position per sequence of operation requirements.

3. Temperature:

    a. Entering air temperature: specified and actual.
    b. Leaving air temperature (in minimum airflow/heating mode): specified and actual.
    c. Entering water temperature: specified and actual.
    d. Leaving water temperature: specified and actual.

4. Pressure Drop and Pressure:

    a. Inlet static pressure during testing cooling maximum airflow rate (maximum and minimum).
    b. Water pressure drop: specified and actual.

H. Air Flow Measuring Station:

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.

5. Size.
6. Flow rate (cfm): specified and actual.
7. Pressure drop: specified and actual.

## 4.3 HEATING SYSTEMS

A. Pump Data (Primary and Secondary Heating Water Loop Pumps):

1. Existing drawing symbol or equipment TAG
2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shutoff.
7. Suction Pressure: Operating and shutoff.
8. Discharge Pressure: Operating and shutoff.
9. Final frequency of motor at maximum flow rate (on pumps driven by VFD).

B. Electric Motors (Associated Heating Water Loop Pump Motors):

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

C. Heating Coils:

1. General Requirements:

   a. Drawing symbol.
   b. Service.
   c. Location.
   d. Manufacturer and model.
   e. Size.

2. Flow Rate:

   a. Flow rate (cfm): specified and actual.
   b. Water flow rate: specified and actual.

3. Temperature:

   a. Entering air temperature: specified and actual.0
   b. Leaving air temperature: specified and actual.
   c. Entering water temperature: specified and actual.
   d. Leaving water temperature: specified and actual.

4. Pressure Drop and Pressure:

   a. Air pressure drop: specified and actual.

b. Steam pressure after valve: specified and actual.
c. Water pressure drop: specified and actual.

5. Energy:

a. Air Btuh (cfm x temp rise x 1.09).
b. Water Btuh (gpm x temp drop x 500). Repeat tests if not within 10% of air Btuh.

D. Terminal Heat Transfer Units:

1. General Requirement:

a. Drawing symbol.
b. Location.
c. Manufacturer and model.
d. Include air data only for forced air units.

2. Flow Rate:

a. Flow rate (cfm): specified and actual.
b. Water flow rate (cfm): specified and actual.

3. Temperature:

a. Entering air temperature: specified and actual.
b. Leaving air temperature: specified and actual.
c. Entering water temperature: specified and actual.
d. Leaving water temperature: specified and actual.

4. Energy:

a. Air Btuh (cfm x temperature rise x 1.09).
b. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

E. Hot Water Boiler:

1. General Requirements:

a. Drawing symbol.
b. Service.
c. Location.
d. Manufacturer, model, and identification number.
e. Control setting: specified and actual.

2. Flow Rate:

a. Flow rate (gpm): specified and actual.

3. Pressure Drop:

a. Pressure Drop: specified and actual.

4. Temperature:

a. Entering water temperature: specified and actual.
b. Leaving water temperature: specified and actual.

5. Energy:

a. Rating (Btuh).
b. Measured output (Btuh).

## 4.4 COOLING SYSTEMS

A. Pump Data:

1. General Requirements:

a. Drawing symbol.
b. Service.
c. Manufacturer, size, and model.
d. Impeller size: specified, actual, and final (if trimmed).
e. Final frequency of motor at maximum flow rate. (On pumps driven by VFD.)

2. Flow Rate:

a. Flow Rate (gpm): specified and actual.

3. Pressure Drop and Pressure:

a. Pump Head: specified, operating and shutoff.
b. Suction Pressure: Operating and shutoff.
c. Discharge Pressure: Operating and shutoff.

B. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps for each phase.

C. Air Cooled Chillers:

1. General Requirements:

a. Drawing symbol.
b. Manufacturer and model.
c. Refrigerant type and capacity.
d. Starter type, size, and thermal protection.
e. Capacity: specified and actual.

2. Temperature:

    a. Evaporator entering water temperature: specified and actual.
    b. Evaporator leaving water temperature: specified and actual.
    c. Condenser entering air temperature.
    d. Condenser leaving air temperature.

3. Pressure Drop and Pressure:

    a. Evaporator pressure drop: specified and actual.

4. Flow Rate:

    a. Evaporator water flow rate: specified and actual.

D. Cooling Coils:

1. General Requirements:

    a. Drawing symbol.
    b. Service.
    c. Location.
    d. Size.
    e. Manufacturer and model.

2. Temperature:

    a. Entering air DB temperature: specified and actual.
    b. Entering air WB temperature: specified and actual.
    c. Leaving air DB temperature: specified and actual.
    d. Leaving air WB temperature: specified and actual.
    e. Entering water temperature: specified and actual.
    f. Leaving water temperature: specified and actual.

3. Flow Rate:

    a. Flow rate (cfm): specified and actual.
    b. Water flow rate (gpm): specified and actual.

4. Pressure Drop and Pressure:

    a. Water pressure drop: specified and actual.
    b. Air pressure drop: specified and actual.

5. Energy:

    a. Air Btuh (cfm x enthalpy change x 4.5).
    b. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

E. Terminal Heat Transfer Units:

1. General Requirements:

    a. Drawing symbol.
    b. Location.
    c. Manufacturer and model.
    d. Include air data only for forced air units.

2. Temperature:

    a. Entering air DB temperature: specified and actual.
    b. Leaving air DB temperature: specified and actual.
    c. Entering water temperature: specified and actual.
    d. Leaving water temperature: specified and actual.

3. Flow rate:

    a. Flow rate (cfm): specified and actual.
    b. Water flow (gpm): specified and actual.

4. Energy:

    a. Air Btuh (cfm x temperature rise x 1.09).
    b. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

**END OF SECTION 230593**

**THIS PAGE INTENTIONALLY LEFT BLANK**

## SECTION 23 07 13 - DUCTWORK INSULATION

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.

B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.

B. Materials:

1. Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
2. Fungal Resistance: No growth when tested in accordance with ASTM G21 (antifungal test).
3. Rated velocity on coated air side for air erosion in accordance with UL 181 at 5,000 fpm minimum.
4. UL listed in Category HNKT.

C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

C. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

E. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750C.

F. ASTM E814 - Fire Tests of Through Penetrations Firestops.

G. ASTM E2336-04 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

I. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

J. NFPA 96 - Standard for the Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

K. NFPA 255 - Surface Burning Characteristics of Building Materials.

L. UL - XHEZ - Through Penetration Firestop Systems.

M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

N. UL 263 - Full Scale External Fire Tests with Hose Stream.

O. UL 723 - Surface Burning Characteristics of Building Materials.

P. UL 1479 - Fire Tests of Through Penetrations Firestops.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and location.

B. Submit manufacturer's installation instructions.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 / 0.26 (Out-Of-Package/Installed-Compressed 25%) maximum 'K' value at 75F; foil scrim Kraft facing, 1.0 lb./cu. ft. density. Submit both "Out of Package" and "Installed-Compressed 25%" K and R-values.

B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75F; foil scrim Kraft facing, 3 lb./cu. ft. density. Provide with canvas jacket. (Mechanical Rooms)

2.2 JACKETS

A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.3 JACKET COVERINGS

A. Aluminum Jackets: ASTM B209; 0.016" thick; smooth or embossed stucco finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.

B. Install materials after ductwork has been tested.

C. Clean surfaces for adhesives.

D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.

E. Exterior Duct Wrap - Flexible, Type A:

1. Apply with edges tightly butted.
2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.
3. Seal joints with adhesive backed tape.
4. Apply so insulation conforms uniformly and firmly to duct.
5. Seal all penetrations of the vapor barrier by strap hangers or slip cable hangers with adhesive backed tape.
6. Provide high-density insulation inserts on rectangular ducts at trapeze duct hangers to prevent crushing of insulation. Provide high-density insulation inserts with clamp-on round ducts requiring two (2) rods or straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.
7. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
8. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.
9. Staples may be used, but must be covered with tape.
10. Vapor barrier must be continuous.

11. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.

F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):

1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.
3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.
4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.

G. Continue insulation with vapor barrier through penetrations unless code prohibits.

H. Provide 2" wide, 24" high, 26 gauge, galvanized sheet metal corner protection angles for all externally insulated ductwork extending to a floor or curb.

**END OF SECTION 230713**

## SECTION 23 07 16 – HVAC EQUIPMENT INSULATION

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment Insulation.

B. Equipment Insulation Finishes.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate

C. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

D. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

E. ANSI/ASTM C534 - Elastomeric Foam Insulation

F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

G. ANSI/ASTM C553 - Mineral Fiber Blanket Thermal Insulation.

H. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

I. ANSI/ASTM C921 - Properties of Jacketing Materials for Thermal Insulation

J. ANSI/ASTM D1668 - Glass Fabric for Waterproofing

K. ASTM E84 - Surface Burning Characteristics of Building Materials.

L. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

M. NFPA 255 - Surface Burning Characteristics of Building Materials.

N. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and locations.

**PART 2 - PRODUCTS**

2.1 INSULATION

A. Type C: Glass Fiber Blanket; ANSI/ASTM C1393 Type IIIA Cat2; 0.40 maximum 'K' value at 300F; 2.5 lb/cu ft.; suitable to 850F, with all service jacket (ASJ) vapor retarder jacket having 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

B. Type E: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534, Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75F, minimum density 3.0 lb/cu.ft (48kg/m3) listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where thicker values are specified.

2.2 INSULATION FINISHES

A. Type 1: Glass Fabric; ASTM D1668, woven glass fabric with two coats of mastic approved for insulation type. Use vapor barrier mastics that are approved for both indoor and outdoor use on insulation systems covering surfaces having temperatures less than 70F and having maximum 0.013 perms/inch rating at 0.043 inch dry-film thickness when tested in accordance with ASTM E-96 Procedure B (Foster 30-80 or approved equivalent). Use breather mastics that are approved for both indoor and outdoor use on insulation systems covering surfaces having temperatures 70F or greater (Foster 35-00 or approved equivalent).

B. Type 2: All Service Jacket; ASTM C921; Factory or Field Applied; all-purpose polymer or polypropylene service jacket; Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Seal all joints with manufacturer approved tape and adhesive to maintain vapor barrier. Indoor use only, if used outdoors add type 4 finish.

C. Type 3: Flexible Elastomeric Thermal Insulation; After adhesive has fully cured, apply two coats of latex enamel paint approved by insulation manufacturer for outdoor use.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install all materials per manufacturer's instructions, codes and industry standards.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.

C. Do not insulate factory insulated equipment.

D. Apply insulation as close as possible to equipment by grooving, scoring, and bevelling insulation. Secure to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier mastic.

F. Do not insulate over nameplates or ASME stamps. Bevel and seal insulation around such, unless omitting insulation would cause condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items.

G. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning; install specially fabricated removable insulation sections. Covers shall have mechanical fasteners and be reusable.

H. Install 26 gauge galvanized sheet metal corner protection angles where insulation extends to the floor. Minimum 2" coverage of insulation.

I. Insulate all equipment surfaces that are not factory insulated and are intended to operate below 60F and/or above 100F. Verify insulation type and thickness with equipment manufacturer and Architect/Engineer.

J. Insulate all supports on equipment operating below ambient temperature.

### 3.2 INSULATION

A. Type C, D and F:

1. Apply with edges tightly butted and joints staggered.
2. Secure with welded pins and washers, 4" from each edge and 16" on center, or 1/2" x 0.015" galvanized steel bands, 12" on center.

B. Type E:

1. Apply with edges tightly butted and joints staggered. Install multiple layers if required thickness is greater than 1" thick.
2. Do not wrap sheet insulation around square corners, but cut and overlap insulation at corners to provide full insulation thickness on all sides. Seal all overlapping insulation surfaces with manufacturer approved adhesive.

3. Secure with manufacturer approved adhesive in accordance with installation instructions. Where applied to underside surfaces or on surfaces with temperatures 140F and above, cover all surfaces with full application of adhesive. Seal all joints and seams with manufacturer approved adhesive.
4. Exterior Installations: Exterior installations shall contain factory applied 17.5 mils laminated UV resistant cladding with ends sealed with adhesive and similar cover; or Contractor shall paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

3.3 SCHEDULE

A. Heating Water Air Separator/Coalescing Filter: 2" thick Type C, Finish 1 or 2.

B. Chilled Water Air Separator/Coalescing Filter: 2" thick Type E, Finish 3.

C. Chilled Water Pumps: 1" thick Type E, Finish 3.

D. Chilled Water Flexible Connections & Expansion Joints: 3/4" thick Type E, Finish 3.

E. Bypass (Pot Feeders):

1. Systems operating between 40F to 70F: 1" thick Type E, Finish 3.
2. Systems operating between 105F to 140F: 1-1/2" thick Type E, Finish 3.

**END OF SECTION 230716**

## SECTION 23 07 19 - HVAC PIPING INSULATION

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.

B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

D. ANSI/ASTM C534 - Elastomeric Foam Insulation.

E. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

H. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.

I. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.

J. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

K. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.

L. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.

M. ASTM E84 - Surface Burning Characteristics of Building Materials.

N. NFPA 255 - Surface Burning Characteristics of Building Materials.

O. UL 723 - Surface Burning Characteristics of Building Materials.

P. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and locations.

## PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75F; non-combustible, minimum density 4.0 lb/cu.ft (48kg/m3). All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

B. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534, Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75F, minimum density 3.0 lb/cu.ft (48kg/m3), listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.

C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.29 maximum 'K' value at 75F; density 7.3lb/cu.ft; minimum compressive strength 90 psi parallel to rise; moisture resistant, non-combustible; suitable for -100F to +900F. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose polymer or polypropylene service jacket for above grade installations.

D. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300F; 1200F maximum service temperature; density 14lb/cu.ft (224kg/m3); 16 gauge stainless steel tie wires on maximum 12" centers.

E. Type E: Preformed rigid cellular polyisocyanurate insulation; ANSI/ASTM C591; maximum 'K' value of 0.19 at 75F; density 4.0lb/cu.ft; minimum compressive strength 95 psi parallel to rise; moisture resistant; listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code; suitable for -297F to +300F.

F. Type F: Phenolic insulation; ASTM C1126; maximum 'K' value of 0.22 at 75F; density 3.75lb/cu.ft; minimum compressive strength 50 psi parallel to rise; moisture resistant; listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code; suitable for -290F to +250F.

G. Type J: Glass Fiber Blanket; ANSI/ASTM C612; 0.40 maximum 'K' value at 300F. 3.0 lb./cu ft density. Suitable for 850F.

## 2.2 VAPOR BARRIER JACKETS

A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

## 2.3 JACKET COVERINGS

A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

B. Plastic Jackets and Fitting Covers: High impact, glossy white, [0.020"][0.030"] thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40F to 150F. Listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

## 2.4 REMOVABLE INSULATION JACKETS

A. Removable insulation jackets shall consist of outer covering, interstitial insulation material, and inner covering.

B. Inner and outer covering shall be constructed from a minimum 16.5 oz./yd2 PTFE fiberglass composite and suitable for insulating surface temperatures up to 500F.

C. Interstitial insulation blanket shall be minimum 1-1/2" thick and shall consist of either:

1. Silica and glass-fiber insulation felts and blankets - minimum 6 lb./ft3 density.
2. E-type glass-fiber felts and blankets - minimum 6 lb./ft3 density.

D. Construction: Inner and outer covering with interstitial insulation material shall be joined into a single assembly using a double sewn lock stitch with 4-6 stitches/inch. The thread used shall be able to withstand minimum 550F surface temperatures without degradation. The use of hog rings, staples, and wires for closure of assembly are not acceptable. The interstitial insulation shall be sewn as an integral part of the inner and outer coverings to prevent shifting of the insulation. Insulation pins are not an allowable method of preventing the insulation from shifting and shall not be used.

E. No raw cut jacket edges shall be exposed.

F. Jackets shall be fastened to equipment and piping components using hook and loop (Velcro) straps and minimum 1" slide buckles.

G. Jacket coverings shall have an inner covering edge with a continuous strip of hook & loop closure (Velcro) that is parallel to the seam and overlaps the outer covering by a minimum of 2 inches.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

B. Patch and repair torn insulation. Paint to match adjacent insulation surface.

### 3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.
2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
3. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has been listed and labeled having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested as a composite in accordance with ASTM E84 or UL 723.
4. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60F:

1. Insulate fittings, valves, unions, flanges, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. On piping operating below 60F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.)
3. All balance valves and strainers with fluid operating below 60F shall be insulated with a removable plug wrapped with vapor barrier tape to allow access for reading and adjusting of the balancing valve and cleaning and servicing of the balancing valve.

C. Insulated Piping Operating Between 60F and 140F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140F:

1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.
2. All balance valves with fluid operating above 140F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.
3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).

E. Refrigerant Piping:

1. On refrigerant piping (25F and above) and not required to meet the 25/50 flame/smoke, provide at each strut or clevis support an insulation coupling to support pipe and to accept insulation thickness of adjoining insulation, to prevent insulation from sagging and crushing. The coupling shall be suitable for planned temperatures, use with specified pipe material, and shall be a 360-degree, one-piece cylindrical segment. Use mechanical fasteners where coupling cannot be installed on pipe during installation. Contractor shall apply adhesive to ends of insulation entering insulation coupling to maintain vapor barrier.

F. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.3 SUPPORT PROTECTION

A. Insulation with pipe size greater than 1-1/2” (38mm) shall be protected from sagging and crushing by one the following means.

1. High Compressive Strength Insert: On all insulated piping greater than 1-1/2", provide shield with high compressive strength insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:

a. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180-degree cylindrical segment the same length as metal shields. Inserts shall be:

b. Cellular glass (Type C) (for all temperature ranges) with a minimum compressive strength of 90 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14, provide rolled steel plate in addition to the shield.

c. Molded hydrous calcium silicate (Type D) (only use for pipes with operating temperatures above 90F, with a minimum compressive strength of 100 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.

d. Polyisocyanurate insulation (Type E) (for pipes below 300F with a minimum compressive strength of 24 psi is acceptable for pipe sizes 3" and below, minimum 60 psi for pipe sizes 4" to 10". For pipe sizes larger than 10", provide rolled steel plate in addition to the shield. Where insulation is installed on piping located within return air plenums and mechanical rooms, insulation shall be listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

e. Phenolic (Type F) (for pipes operating below 250F with a minimum compressive strength of 90 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.

f. Provide metal shields between hangers or supports and the pipe insulation/insert. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

1) Shields shall be at least the following lengths and gauges:

| Pipe Size | Shield Size |
|---|---|
| 1/2" to 3-1/2" | 12" long x 18 gauge |
| 4" | 12" long x 16 gauge |
| 5" to 6" | 18" long x 16 gauge |
| 8" to 14" | 24" long x 14 gauge |
| 16" to 24" | 24" long x 12 gauge |

g. Where rolled steel plate is noted above, provide minimum 1/4" rolled galvanized steel plates in addition to the shield as reinforcement on large pipes as noted above to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength.

2. Premanufactured Insulation Insert/Shield: As an alternative to separate pipe insulation insert and saddle, properly sized manufactured integral rigid insulation insert and shield assemblies may be used.
3. Premanufactured Insulation Couplings:

a. Molded thermoplastic slip coupling, -65F to 275F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.

b. PET thermoplastic foam load bearing core with elastomeric foam ends and lap-seal jacket.

c. Horizontal Strut Mounted Insulated Pipe Manufacturers:

1) Klo-Shure or equal
2) Armafix Ecolight

d. Vertical Manufacturers:

1) Manufacturers: Klo-Shure Titan or equal

4. Premanufactured shield/saddle for use with Elastomeric Foam (Type B): molded thermoplastic rigid pipe saddle sized for insulation outside diameter. Length as required by manufacturer.

B. Rectangular blocks, plugs, or wood material are not acceptable.

C. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.

D. Neatly finish insulation supports, protrusions, and interruptions.

E. Ferrous hot piping 4 inches and larger, provide steel saddle at rollers as described in Section 23 05 29 "HVAC Supports and Anchors".

## 3.4 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.

2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Install per manufacturer's instructions or ASTM C1710.
2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Exterior installations shall contain factory applied polymeric, moisture, and UV resistant covering with ends sealed with adhesive and similar cover; or Contractor shall paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
3. Insulation Installation on Straight Pipes and Tubes:

    a. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
    b. Insulation must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.

4. Insulation Installation on Valves and Pipe Specialties:

    a. Install preformed sections of same material as straight segments of pipe insulation when available.
    b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
    c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.
2. Insulate fittings with prefabricated fittings.

D. Type D Insulation:

1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.

2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.

E. Type E Insulation:

1. Indoors, above grade or below grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
2. Insulate pipe fittings with prefabricated insulation fittings.

F. Type F Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive or mastic. Secure butt joint strips in a similar manner.
2. Indoors, above grade or below grade, polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
3. Insulate pipe fittings with prefabricated insulation fittings.

G. Type H, I, and J Insulation:

1. Apply with edges tightly butted, joints broken.
2. Secure with 16 gauge galvanized, annealed steel wire or 1/2" x 0.015" galvanized steel bands, 12" maximum centers.
3. Install welding studs, clips and angles where required to anchor wires and bands.

H. Type K Insulation:

1. Indoors, above grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
2. Insulate fittings with prefabricated fittings.

## 3.5 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.
2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.
3. Interior joints do not need to be sealed.

4. Use colored aluminum jacket covers on the following pipes:

   a. All exterior piping.

B. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.
3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1" on circumferential and 1.5" to 2" on longitudinal seams.
5. Use plastic insulation covering on all exposed pipes including, but not limited to:

    a. All exposed piping in finished spaces unless noted otherwise on the drawings.
    b. All exposed piping in unfinished areas as noted on drawings (e.g., storage rooms, janitor's closets, utility rooms, etc.).
    c. All exposed piping in mechanical or equipment rooms below 8'-0" above floor.
    d. All exposed piping in mechanical rooms that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)

6. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.

3.6 SCHEDULE

A. Heating hot water supply to and return piping, fittings, valves elbow, etc. to be insulated with Type A. Exposed fittings shall be finished with Plastic jacket. Piping 2" or less shall have 1" thick insulation. Piping larger than 1" shall have 2" thick insulation.

B. Chilled water supply and return piping, fittings, valves, elbow, etc. to be insulated with Type E. Exposed fittings shall be finished with Plastic jacket. Piping 2" or less shall have 1" thick insulation. Piping larger than 1" shall have 2" thick insulation. Exposed piping on exterior of building shall be insulated with Type E and covered with aluminum jacket

C. Refrigerant piping to be Type B.

D. All condensate drain piping, make-up water piping, refrigerant piping exposed on exterior of building shall be Type B covered with aluminum jacket.

**END OF SECTION 230719**

## SECTION 23 08 00 – MECHANICAL COMMISSIONING REQUIREMENTS

## PART 1 - GENERAL

1.1 DESCRIPTION

A. Commissioning

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:

1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper functional performance of equipment and systems.
3. Verify that O&M documentation left on site is complete.
4. Verify that the Owner's operating personnel are adequately trained.

1.2 RELATED WORK

A. Section 23 0900 – Instrumentation and Controls for HVAC

1.3 ABBREVIATIONS AND DEFINITIONS

A. A/E: Architect, Architect/Engineer, Engineer and/or Design-Builder

B. ASI: Architectural Supplemental Instruction

C. BAS: Building Automation System

D. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR.

E. CxA: Commissioning Authority

F. CC: Controls Contractor

G. CM: Construction Manager

H. Cx: Commissioning

I. Cx Plan: Commissioning Plan

J. DDC: Direct Digital Control System

K. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.

L. FT: Functional Performance Test

M. MC: Mechanical Contractor

N. O&M: Operation and Maintenance

O. OPM: Owner Project Manager

P. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.

Q. PC: Prefunctional Checklist

R. Sub(s): Subcontractors or Prime Contractor

S. TAB: Test, Adjust and Balance

## 1.4 MECHANICAL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. Mechanical Systems

1. All 4-pipe variable air volume air handling units
2. Terminal Air Boxes
3. Fan Coils
4. Air Cooled chiller and pumps
5. Gas fired condensing boilers and pumps.
6. Heat Pumps
7. Test, Adjust, and Balance of HVAC air systems.
8. Exhaust Fans
9. Make up water submeter

B. Building Automation Systems (BAS)

1. The entire BAS shall be subject to commissioning, including all hardware components, software, networking, programming and engineering services, and controls documentation.
2. Any systems connected to the BAS (monitoring or otherwise) are subject to be commissioned including water meters.

## 1.5 SUBMITTALS

A. Provide the CxA a copy of the following items, for the systems to be commissioned:

1. Equipment and System Submittals to include, at minimum, the following:

a. Equipment Data Sheets

b. Performance data
c. Manufacturer's pre-startup checklists
d. Manufacturer's start-up checklists
e. Installation Instructions

2. Test, Adjust, and Balance (TAB) Reports

a. Planning Report - TAB contractor shall submit one copy of planning report (execution plan) to the CxA for review prior to beginning TAB work. At a minimum this report should include:
1) Certifications on all instruments to be used throughout the testing. Certification must be documented within the previous 6 months.
2) Résumés and Certification of individuals who will be balancing the systems.
3) Detailed step-by-step plans for each procedure to be performed by the TAB Contractor.
4) Sample forms to be used for each measurement.

b. Initial Test Report – Prior to starting final Balance Phase, submit a copy of the initial test report (TAB punchlist) to the CxA to indicate problem areas to be resolved before final balance is completed.
c. Final Report – Submit one copy of final test report to the CxA within 7 days after fieldwork is complete.

3. Shop drawings (including any resubmittals required by the A/E)
4. Piping - Supply one copy of all hydrostatic pressure test results
5. Initial Pre-startup and start-up plan
6. Startup Testing Report

a. Prepare startup testing report on a per system basis, documenting the results of executed testing plan.
b. Copies of all completed test forms and checklists shall be provided.
c. List of all outstanding deficiencies and uncompleted items.

7. Operational and maintenance documentation
8. Training plan and training materials
9. As-built documentation

1.6 SEQUENCE OF OPERATIONS

A. See Mechanical plans for more information.

**PART 2 - PRODUCTS**

2.1 TEST EQUIPMENT

A. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Refer to respective specification sections for testing procedures.

2.2 Cx WEB-BASED COMMISSIONING TOOL

A. All web-based software required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Refer to respective specification sections for testing procedures.

**PART 3 - EXECUTION**

3.1 MEETINGS

A. Prior to the start of construction, the mechanical and controls contractor will schedule a meeting with the commissioning authority to review the systems to be commissioned, the testing methodology, and other requirements.

3.2 START-UP, PRE-FUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

A. General

1. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
2. The prefunctional performance test checklists shall be developed by the CxA.

B. Start-up and Initial Checkout Plan

1. The subcontractor responsible for providing and installing the equipment shall develop the full start-up plan by combining the prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checkout and inspection of each piece of equipment and a summary statement with a signature block at the end of the checklist.
2. The full start-up plan shall consist of:

    a. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
    b. The manufacturer's normally used field checkout sheets
    c. Specifically, the mechanical start-up plan shall also include the contractors TAB plan.

3. The contractor submits the full startup plan to the CxA for review and approval.
4. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.

C. Execution of Prefunctional Checklists and Startup

1. Two weeks prior to startup, the Subs and vendors schedule startup and checkout with the OPM, CM and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CxA and possibly the A/E will observe the procedures for selected pieces of primary equipment. It is the intent that the commissioning authority will observe the tests during contractor testing. If the contractor does not inform the commissioning authority of testing, the commissioning authority may request the contractor to repeat the test.
3. The CxA will observe the physical start-up of all major systems.
4. For lower-level components of equipment, (e.g., sensors, controllers), the CxA will observe a sampling of the prefunctional and start-up procedures.
5. The Subs and vendors shall execute startup and provide the CM with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The CM reviews for completion and accuracy, then submits to the CxA.
6. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
7. Completed startup test report must be provided to CxA prior to functional testing.

D. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The CxA will work with the Subs and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the PM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

## 3.3 FUNCTIONAL PERFORMANCE TESTING

A. This sub-section applies to functional testing and demonstration for equipment and system in this division. The functional testing check list shall be developed by the CxA.

B. The general list of equipment and systems to be commissioned is found in section 1.4.

C. Objectives and Scope

1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
2. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, failures, interlocks, warm-up, safety, etc.) where there is a

specified system response. Verifying each sequence in the sequence of operation is required.

3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before functional testing commences.

D. Development of Test Procedures

1. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, OPM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems related to feasibility, safety, equipment and warranty protection.

E. Coordination and Scheduling

1. The CM shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the CM and affected Subs. Completed startup testing report must be provided to CxA prior to functional testing. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Further, mechanical system functional testing shall not be scheduled until the final TAB report is approved and all reported deficiencies by TAB firm are corrected. Scheduling of functional testing shall be done with a minimum of two weeks notice prior to testing. Functional testing of the equipment and systems listed in section 1.4 of this specification section shall not be conducted out of the presence of the CxA and OPM, unless specifically approved to do so in writing by the CxA or OPM. Any functional testing which occurs outside the presence of the CxA or OPM without written authorization to do so will be required to be re-tested at no expense to the owner.

F. Test Methods

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when

possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair dryer rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.

4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55ºF, when the outside air temperature is above 55ºF, temporarily change the lockout setpoint to be 2ºF above the current outside air temperature.
6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

G. Demonstration, Verification and Validation

1. TAB Validation

a. The air balancing is de-bugged, completed and approved before the CxA completes a TAB validation of air-related and water-related equipment or systems. The CxA will direct a TAB checkout by verifying the values reported in the final TAB report. The contractor shall supply all personnel and equipment for the checkout, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. The TAB verification shall verify:

1) Grilles, diffusers, and registers
2) All terminal devices, air and water
3) All main HVAC systems.
4) All exhaust fans
5) All pumps
6) Boilers and Chiller

2. Metering System

a. Demonstrate meters are calibrated in accordance with the manufacturer's published data approved.
b. Demonstrate accuracy of all meters.
c. Demonstrate utility monitoring integration with BAS.

H. Problem Solving

1. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the CM, Subs and A/E.

3.5 OPERATION AND MAINTENANCE MANUALS

A. In addition to Installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing. O&M Manuals shall be in electronic form, the file format shall be Adobe Acrobat readable document. The document shall be formatted to include level 1 bookmarks that link to each main section of equipment.

3.6 TRAINING OF OWNER PERSONNEL

A. CxA shall document the completion of comprehensive Owner training. Training shall include the understanding of the systems and the operation and maintenance of each major piece of HVAC equipment or system.

B. Training shall include classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including all HVAC Systems, Controls, Exhaust Fans, etc.

**END OF SECTION 230800**

## SECTION 23 09 00 - CONTROLS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Complete System of Automatic Controls.

B. Control Devices, Components, Wiring and Material.

C. Instructions for Owners.

D. Remodeling.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years' experience.

B. TCC: Company specializing in the work of this section with minimum five years temperature control experience.

C. Technician: Minimum five years' experience installing commercial temperature control systems.

D. TCCs are limited to firms regularly employing a minimum of five full-time temperature control technicians within 100 miles of the job site.

1.3 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/ASHRAE Standard 135-2020: BACnet® - A Data Communication Protocol for Building Automation and Control Networks, including all amendments.

D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).

E. ANSI/NFPA 70 - National Electrical Code.

F. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

G. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

H. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.

I. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

J. ANSI/ASTM B32 - Solder Metal.

K. ASTM B280 - Seamless Copper Tube for Air Conditioning & Refrigeration Field Service.

L. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

## 1.4 SUBMITTALS

A. Equipment Coordination:

1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.
2. Control valve selections shall be based on flow rates shown in approved shop drawings.
3. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.

B. Shop Drawings:

1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop drawings in Adobe Acrobat (.pdf) format to the Owner for review.
2. Cross-reference all control components and point names in a single table located at the beginning of the submittal with the identical nomenclature used in this section.
3. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.
4. System Architecture: Provide riser diagrams of wiring between central control unit and all control panels. This shall include specific protocols associated with each level within the architecture. Identify all interface equipment between CPU and control panels. The architecture shall include interface requirements with other systems including, but not limited to, security systems, lighting control, fire alarm, elevator status, and power monitoring system.
5. Diagrams shall include:

    a. Wiring diagrams and layouts for each control panel showing all termination numbers.
    b. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.

c. Identification of all control components connected to emergency power.
d. Schematic diagrams for all field sensors and controllers.
e. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.
f. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, label it with the same name. Label all terminals.
g. A tabular instrumentation list for each controlled system. The table shall show element name, type of device, manufacturer, model number and product data sheet number.
h. All installation details and any other details required to demonstrate that the system will function properly.
i. All interface requirements with other systems.

6. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications.
7. Sequences: Submit a complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Architect/Engineer. Clearly highlight any deviations from the specified sequences on the submittals.
8. Points List Schedule: Submit a complete points list of all points to be connected to the TCS and FMCS. The points list for each system controller shall include both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, the location of the I/O device, and reference drawings. Where a control point is the same as that shown on the control system schematic, label it with the same name. Points list shall specifically identify alarms, trends, event history, archive, totalization, graphic points, and all mapped points from other systems (security systems, lighting control, fire alarm, etc.). Provide points lists, point naming convention, and factory support information for systems provided and integrated into the FMCS.
9. Damper Schedule: Schedule shall include a separate line for each damper and a column for each of the damper attributes:

a. Damper Identification Tag.
b. Location.
c. Damper Type.
d. Damper Size.
e. Duct Size.
f. Arrangement.
g. Blade Type.
h. Velocity.
i. Pressure Drop.
j. Fail Position.

k. Actuator Identification Tag.
l. Actuator Type.
m. Mounting.

10. Valve Schedule: Valve manufacturer shall size valves and create a valve schedule. Schedule shall include a separate line for each valve and a column for each of the valve attributes:

    a. Valve Identification Tag.
    b. Location.
    c. Valve Type.
    d. Valve Size.
    e. Pipe Size.
    f. Configuration.
    g. Flow Characteristics.
    h. Capacity.
    i. Valve CV.
    j. Design Pressure Drop.
    k. Pressure Drop at Design Flow.
    l. Fail Position.
    m. Close-off Pressure.
    n. Valve and Actuator Model Number and Type.

11. Indoor modular air handling units (Section 23 73 13) and mixed flow return air fans (Section 23 34 13) provided under this project will have piezometer type sensors mounted at fan inlets by fan manufacturer. Fan manufacturer will provide fan specific flow coefficients and equations that can be used to calculate fan airflow based on measured pressure differential at fan inlet. TCC shall provide the following:

    a. Quantity of pressure transducers so that each individual fan is served by a dedicated pressure transducer. Each pressure transducer shall have a range that is selected based on scheduled maximum airflow for each fan. TCC shall submit a schedule that shows the following calculations for each fan/pressure transducer:

        1) Pressure drop at maximum scheduled airflow for each fan using fan manufacturer's flow coefficient.
        2) Recommended transducer range.

    b. Pneumatic tubing as required to interconnect all piezometer type sensors and pressure transducer. Note: Where UV lamps are installed upstream of supply fan inlets, only copper tubing shall be used.
    c. Fasteners and supports as required to securely attached tubing, pressure transducers, conduits, wiring, and the like for a complete installation.

12. Airflow Measuring Station Schedule:

a. The manufacturer's authorized representative shall prepare the airflow measuring station submittal, or review and approve in writing the submittal prepared by the TCC prior to submission to the Architect/Engineer and prior to installation. The representative shall review air handling equipment submittals and duct fabrication drawings to ensure that all AFMS locations meet the appropriate parameters to achieve proper installation and the specified accuracy. Comply with all manufacturer's installation requirements including straight up and downstream duct lengths. Install airflow straighteners if required by the manufacturer based on installation constraints. The Architect/Engineer shall be notified for approval of any deviations.
b. Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system.
c. Submit installation, operation, and maintenance documentation.

13. Product Data Sheets: Required for each component that includes: unique identification tag that is consistent throughout the submittal, manufacturer's description, technical data, performance curves, installation/maintenance instructions, and other relevant items. When manufacturer's literature applies to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements.
14. Provide PICS files indicating the BACnet functionality and configuration of each device.
15. Provide documentation of submitted products that have been tested and listed by the BACnet Testing Laboratory (BTL), or provide a letter on the manufacturer's company letterhead indicating the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing and listing has not been completed, a written commitment to upgrade installed controls to a version that meets BTL testing and listing requirements if problems are found during BTL testing is required.
16. Graphic Display: Include a sample graphic of each system and component identified in the points list with a flowchart (site map) indicating how the graphics are to be linked to each other for system navigation.
17. Software: A list of operating system software, operator interface software, color graphic software, and third-party software.
18. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.
19. Clearly identify work by others in the submittal.
20. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.

C. Operation and Maintenance Manual:

1. In addition to the requirements of Section 23 05 00, submit an electronic copy of the O&M manuals in PDF format.
2. Provide three complete sets of manuals.
3. Each O&M manual shall include:

a. Table of contents with indexed tabs dividing information as outlined below.
b. Definitions: List of all abbreviations and technical terms with definitions.
c. Warranty Contacts: Names, addresses, and 24-hour telephone numbers of contractors installing equipment and controls and service representatives of each.
d. Licenses, Guarantees, and Warranties: Provide documentation for all equipment and systems.
e. System Components: Alphabetical list of all system components, with the name, address, and telephone number of the vendor.
f. Operating Procedures: Include procedures for operating the control systems; logging on/off; enabling, assigning, and reporting alarms; generating reports; collection, displaying, and archiving of trended data; overriding computer control; event scheduling; backing up software and data files; and changing setpoints and other variables.
g. Programming: Description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.
h. Engineering, Installation, and Maintenance: Explain how to design and install new points, panels, and other hardware; recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions; how to debug hardware problems; and how to repair or replace hardware. A list of recommended spare parts.
i. Original Software: Complete original issue CDs for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
j. Software: One set of CDs containing an executable copy of all custom software created using the programming language, including the setpoints, tuning parameters, and object database.
k. Graphics: A glossary or icon symbol library detailing the function of each graphic icon and graphics creation and modification. One set of CDs containing files of all color graphic screens created for the project.

D. Training Manual:

1. Provide a course outline and training manuals for each training class.

E. Record Documents:

1. Submit record documentation per Section 23 05 00.
2. Provide a complete set of "as-built" drawings and application software on CDs. Provide drawings as AutoCAD¢¢ or Visio¢¢ compatible files. Provide two copies of the "as-built" drawings with revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF format.

3. Submit two hard copies and one electronic copy of as-built versions of the shop drawings, including product data and record drawings with revisions clearly indicated. Provide floor plans showing actual locations of control components including panels, thermostats, sensors, and hardware.
4. Provide all completed testing and commissioning reports and checklists, along with all trend logs for each system identified in the points lists.
5. Submit printouts of all graphic screens with current values (temperatures, pressures, etc.) to the Architect/Engineer verifying completion and proper operation of all points.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

## 1.6 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Control Valves.

B. Flow Switches.

C. Temperature Sensor Sockets.

D. Gauge Taps.

E. Automatic Dampers.

## 1.7 AGENCY AND CODE APPROVALS

A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.

1. UL-916; Energy Management Systems.
2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "Signal Equipment."
3. EMC Directive 89/336/EEC (European CE Mark).
4. FCC, Part 15, Subpart J, Class A Computing Devices.

## 1.8 ACRONYMS

A. Acronyms used in this specification are as follows:

1. B-AAC BACnet Advanced Application Controller

2. B-ASC BACnet Application Specific Controller
3. BTL BACnet Testing Laboratories
4. DDC Direct Digital Controls
5. FMCS Facility Management and Control System
6. GUI Graphic User Interface
7. IBC Interoperable BACnet Controller
8. IDC Interoperable Digital Controller
9. LAN Local Area Network
10. NAC Network Area Controller
11. ODBC Open DataBase Connectivity
12. OOT Object Oriented Technology
13. OPC Open Connectivity via Open Standards
14. PICS Product Interoperability Compliance Statement
15. PMI Power Measurement Interface
16. POT Portable Operator's Terminal
17. TCC Temperature Control Contractor
18. TCS Temperature Control System
19. WAN Wide Area Network
20. WBI Web Browser Interface

## 1.9 SUMMARY

A. Provide new standalone FMCS for this project.

B. Niagara Framework/Tridium Based Control System: The TCS provided by the TCC must use the BACnet communication protocol over the standard network. All DDC controllers used in the HVAC controls and lighting controls must be provided with Tridium AX Wizards for use within the Niagara framework.

C. TCC shall furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital Controls as shown on the drawings and as described herein.

D. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Owner.

E. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

## 1.10 SYSTEM DESCRIPTION

A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating via the following protocol to an NAC. Temperature Control System products shall be as specified below.

B. The FMCS shall include Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the Owner's local or wide area network, depending on configuration. Provide access to the system, either locally in each building or remotely from a central site or sites, through standard Web browsers, via the Internet, and/or via local area network.

C. Provide materials and labor necessary to connect factory supplied control components.

D. Provide central and remote hardware, software, and interconnecting wire and conduit.

E. The FMCS shall include automated alarming software capable of calling e-mail compatible cellular telephones and pagers. The e-mail alarm paging system shall be able to segregate users, time schedules, and equipment and be capable of being programmed by the Owner.

F. For the dedicated configuration tool provided, it is preferable that it be launched from within the applicable Network Management Software. If not, include any software required for controller configuration as a leave-behind tool with enough license capability to support the installation.

G. For each operator workstation provided, furnish one legal copy of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be readily available in the market. Contractor shall convey to the Owner all software tools and their legal licenses at project closeout.

H. Niagara Framework (Definition):

1. Niagara Framework: A set of hardware and software specifications for building and utility control owned by Tridium Inc. and licensed to multiple vendors. The framework consists of front end (M&C) software, web-based clients, field level control hardware, and engineering tools.
2. Niagara Framework Supervisory Gateway: DDC hardware component of the Niagara Framework. A typical Niagara architecture has Niagara-specific supervisory gateways at the IP level and other (non-Niagara specific) controllers on field networks (TP/FT-10, MS/TP, etc.) beneath the Niagara supervisory gateways. The Niagara specific controllers function as a gateway between the Niagara framework protocol (Fox protocol) and the field network beneath. These supervisory gateways may also be used as general-purpose controllers and also have the capability to provide a web-based user interface. Note that different vendors refer to this component by different names. The most common name is "JACE", which is used in this specification generically; other names include (but are not limited to)"EC-BOS", "FX-40", "TMN", "SLX" and "UNC".

I. Connection:

1. System shall be a complete hard-wired system. Wireless control systems/functions are NOT acceptable.

## 1.11 SOFTWARE LICENSE AGREEMENT

A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job-specific configuration documentation, data files, configuration tools, and application-level software developed for the project. This shall include, but is not limited to, all custom, job-specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN/WAN/intranet and/or Internet connected routers and devices. Provide the Owner with all required IDs and passwords for access to any component or software program. The Owner shall determine which organizations shall be named in the SI organization ID ("orgid") of all software licenses. Owner shall be free to direct the modification of the "orgid" in any software license, regardless of supplier.

B. For Niagara based systems, it is the express goal of this specification to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

1. All Niagara Framework components have an unrestricted interoperability license with a Niagara Compatibility Statement (NiCS) following the Tridium Open NiCS Specification and have a value of "ALL" for "Station Compatibility In", "Station Compatibility Out", "Tool Compatibility In", and "Tool Compatibility Out". Note that this will result in the following entries in the license file:

    a. accept.station.in="*"
    b. accept.station.out="*"
    c. accept.wb.in="*"
    d. accept.wb.out="*"

2. The Owner shall be free to direct the modification of the any software license, regardless of supplier. In addition, the Owner shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job-specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use within Niagara Framework (Niagara)-based controllers and/or servers and any related LAN/WAN / intranet and internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the Owner. Provide all software necessary for developing software algorithms in all supervisory, programmable, and application specific direct digital controllers that are licensed to the Owner.
3. Programming tools for programmable and application specific controllers that use the Niagara Framework shall not be restricted to any specific brand of JACE. Tools and controllers shall be able to connect to any brand of JACE that are provided under this specification section.

a. For each application generic controller with a Niagara Framework Wizard and for each application specific controller, provide Niagara Framework Wizards.
b. For each Niagara Framework Supervisory Gateway, provide a backup of all software within the Niagara Framework Supervisory Gateway, including configuration settings. This backup must be sufficient to allow restoration of the Niagara Framework Supervisory Gateway or the replacement of the Niagara Framework Supervisory Gateway.
c. Provide a Niagara Framework Engineering Tool. Submit software user manuals with the Niagara Framework Engineering Tool submittal.
d. Provide the Niagara Station ID for each Niagara Framework Supervisory Gateway.

C. The energy metering system is a Tridium-based system using JACE's with I/O modules for single inputs and direct communications to meters that provide multiple points of data. All meters, metering points, and wiring are furnished and installed by the TCC.

## 1.12 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

## 1.13 WARRANTY

A. Refer to Section 23 05 00 for warranty requirements.

B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.

C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.

D. Update all software and back-ups during warranty period and all user documentation on the Owner's archived software disks.

## 1.14 WARRANTY ACCESS

A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. BACnet Protocol[ with Tridium Niagara Platform]:

1. Automated Logic Corp (ALC/Carrier) WebCTRL
2. Delta Controls: ORCA
3. Honeywell
4. Johnson Controls: Metasys Extended Architecture
5. Siemens Building Technologies: DESIGO
6. Schneider Electric - EcoStruxure Building Operation
7. Trane Tracer SC
8. Distech Controls

B. LonTalk Protocol:

1. Honeywell
2. Johnson Controls: Metasys Extended Architecture
3. Schneider Electric - EcoStruxure Building Operation
4. Trane Tracer SC
5. Distech Controls

2.2 SYSTEM ARCHITECTURE

A. General:

1. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall consist of a network of interoperable, standalone digital controllers, a computer system, graphic user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.
2. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

B. Open, Interoperable, Integrated Architectures:

1. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data are not acceptable.
2. The supplied system must be able to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs are not acceptable.
3. Hierarchical or "flat" topologies are required to have system response times as indicated below and to manage the flow and sharing of data without unduly burdening the customer's internal intranet network.

a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

C. Systems Containing Emergency Power / Critical Systems:
1. Controllers serving equipment connected to the emergency power systems shall remain fully operational and maintain communication with the central workstation during loss of normal power.
2. The BAS communication network shall be designed so that loss of power to controllers, switches, or other network devices connected to normal power shall not interrupt communication between the workstation and controllers serving emergency-powered equipment.
3. Where BAS communication networks include both normal-power and emergency-power devices, the contractor shall configure the network architecture to maintain communication to all emergency-powered controllers during loss of normal power. Acceptable methods include, but are not limited to:
a. Dedicated communication networks for emergency-powered controllers.
b. Network switches serving emergency-powered equipment connected to emergency power.
c. Network topologies that maintain communication path during device power loss (e.g., ring or redundant architectures).
d. Controllers capable of maintaining communication pass-through during loss of controller power.
4. Under no circumstances shall communication to emergency-powered controllers rely solely on network devices powered from normal power.

## 2.3 NETWORKS

A. The Local Area Network (LAN) shall be a 100 megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP. Provide support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE Standard 802.3.
2. Cable; 100 Base-T, UTP-8 wire, Category 6.
3. Minimum throughput; 100 Mbps.

C. Communication conduits shall not be installed closer than six feet from 110VAC or higher transformers or run parallel within six feet of electrical high-power cables. Route the cable as far from interference generating devices as possible. Where communication wire must cross 110VAC or higher wire, it must do so at right angles.

D. Ground all shields (earth ground) at one point only to eliminate ground loops. Provide all shield grounding at the controller location, with the shield at the sensor/device end of the applicable wire being left long and "safed" off in an appropriate manner.

E. There shall be no power wiring more than 30 VAC rms run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, run all communication wiring and signal wiring using separate twisted pairs (24awg) in accordance with the manufacturer's wiring practices.

## 2.4 REMOTE NETWORK ACCESS

A. For Local Area Network installations, provide access to the LAN from a remote location via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

## 2.5 NETWORK AREA CONTROLLER (NAC)

A. The TCC shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of NACs required depends on the type and quantity of devices provided under Divisions 23 and 26. The TCC shall determine the quantity and type of devices.

B. NAC shall be provided with open connectivity to any manufacturer's BACnet programmable or application specific direct digital controllers. These controllers shall be JACE 8000 Series models or the identical hardware private label equivalent. The programmable controllers and application specific controllers provided under this section shall be able to be programmed by their respective engineering software application tools through the Niagara-based supervisory controllers from the Ethernet level network. The engineering software application tools shall be able to be loaded on a personal computer with Ethernet connectivity, and no additional hardware shall be required to connect to and download any programmable or application specific controller.

C. Each NAC shall provide the interface between the LAN or WAN and the field control devices and shall provide global supervisory control functions over the control devices connected to the NAC. It shall execute application control programs to provide:

1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration of all controller data.
7. Network Management functions.

D. The Network Area Controller shall provide the following hardware features as a minimum:

1. One Ethernet Port - 10/100 Mbps.
2. One RS-232 port.

3. One LonWorks Interface Port - 78KB FTT-10A (for LonWorks systems only).
4. Battery backup.
5. Flash memory for long-term data backup. (If battery backup or flash memory is not supplied, the controller shall contain a hard disk with at least 1 gigabyte storage capacity.)
6. The NAC must be capable of operation over a temperature range of 32F to 122F.
7. The NAC must be capable of withstanding storage temperatures of between 0F and 158F.
8. The NAC must be capable of operation over a humidity range of 5% RH to 95% RH, non-condensing.

E. The NAC shall provide multiple user access to the system and support for ODBC or SQL. Databases resident on the NAC shall be ODBC-compliant or must provide an ODBC data access mechanism to read and write data stored within it.

F. The NAC shall support standard Web browser access via the Internet or an intranet and a minimum of five (5) simultaneous users.

G. Event Alarm Notification and Actions:

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a LAN, remote via dial-up telephone connection, or WAN.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:

    a. Alarm
    b. Normal

4. Provide for the creation of a minimum of eight alarm classes with different routing and acknowledgement properties, e.g. security, HVAC, Fire, etc.
5. Provide timed (scheduled) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object "runtime" and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

H. Treat control equipment and network failures as alarms and annunciated.

I. Annunciate alarms in any of the following manners as defined by the user:

1. Screen message text.
2. E-mail of the complete alarm message to multiple recipients. Provide the ability to route and e-mail alarms based on:

    a. Day of week.
    b. Time of day.
    c. Recipient.

3. Pagers via paging services that initiate a page on receipt of e-mail message.

4. Graphic with flashing alarm object(s).
5. Printed message, routed directly to a dedicated alarm printer.

J. The FMCS shall record the following for each alarm:

1. Time and date.
2. Location (building, floor, zone, office number, etc.).
3. Equipment tag.
4. Acknowledge time, date, and user who issued acknowledgement.
5. Number of occurrences since last acknowledgement.

K. Give defined users proper access to acknowledge any alarm.

L. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

M. Provide a "query" feature to allow review of specific alarms by user-defined parameters.

N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

O. An error log to record invalid property changes or commands shall be provided and available for review by the user.

## 2.6 BACNET FMCS

A. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices in the system. Adherence to industry standards including the latest ANSI/ASHRAE Standard 135 (BACnet) to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP) and/or RS-485 (BACnet MSTP).

C. Interoperable BACnet Controller (IBC):

1. Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with the latest ANSI/ASHRAE Standard 135. Provide IBCs for unit ventilators, fan coils, heat pumps, terminal air boxes (TAB) and other applications. The application control program shall reside in the same enclosure as the input/output circuitry that translates the sensor signals. Provide a PICS document showing the installed system's compliance level to ANSI/ASHRAE Standard 135. Minimum compliance is Level 3.

2. The IBCs shall be listed by the BACnet Testing Laboratory (BTL) as follows:

    a. BACnet Building Controller(s) (B-BC).
    b. BACnet Advanced Application Controller(s) (B-AAC).
    c. BACnet Application Specific Controller(s) (B-ASC).

3. The IBCs shall communicate with the NAC.
4. Each IBC sensor shall connect directly to the IBC and shall not use any of the I/O points of the controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBC sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBC controller is connected. The IBC sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the POT.
5. All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable) require a 10% spare point capacity to be provided for all applications. Store all control sequences within or programmed into the IBC in non-volatile memory that does not depend on a battery to be retained.
6. The Contractor supplying the IBCs shall provide documentation for each device, with the following information at a minimum:

    a. BACnet Device; MAC address, name, type and instance number.
    b. BACnet Objects; name, type and instance number.

7. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each IBC.

D. Object Libraries:

1. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
2. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
3. In addition to the standard libraries specified here, the system supplier shall maintain an on-line accessible (over the Internet) library, available to all registered users, to provide new or updated objects and applications as they are developed.
4. All control objects shall conform to the control objects specified in the BACnet specification.
5. The library shall include applications or objects for the following functions, at a minimum:

    a. Scheduling Object: The schedule must conform to the schedule object as defined in the BACnet specification, providing seven-day plus holiday and temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphic sliders to speed creation and selection of on-off events.

b. Calendar Object: The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphic "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
c. Override Object: Provide override object that is capable of restarting equipment turned off by other energy saving programs to maintain occupant comfort or for equipment protection.
d. Start-Stop Time Optimization Object: Provide a start-stop time optimization object to start equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled unoccupied time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start-stop time object properties based on historical performance.
e. Demand Limiting Object: Provide a demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, gas, etc.). The object shall be able to monitor a demand value and predict (using a sliding window prediction algorithm) the demand at the end of the user-defined interval period (1 to 60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user-defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment setpoints to provide the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the setpoint, display a message on the user's screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to provide both equipment protection and occupant comfort.

6. The library shall include control objects for the following functions:

a. Analog Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
b. Analog Output Object: Minimum requirement is to comply with the BACnet standard for data sharing.
c. Binary Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment runtime by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.

d. Binary Output Object: Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as start-to-start delay must be provided. Incorporate the BACnet Command Prioritization priority scheme to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide 16 levels of priority as a minimum. Systems not employing the BACnet method of contention resolution are not acceptable.
e. PID Control Loop Object: Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable to allow proportional control only, or proportional with integral control, or proportional, integral and derivative control.
f. Comparison Object: Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
g. Math Object: Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
h. Custom Programming Objects: Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including, but not limited to, math and logic functions and string manipulation. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for reuse.
i. Interlock Object: Provide an interlock object that provides a means of coordination of objects within a piece of equipment, such as an air handler or other similar types of equipment. An example is to link the return fan to the supply fan such that, when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming, thereby eliminating nuisance alarms during the off period.
j. Temperature Override Object: Provide an object whose purpose is to override a binary output to an "on" state in the event a user-specified high or low limit value is exceeded. Link this object to the desired binary output object as well as to an analog object for temperature monitoring to cause the override to be enabled. This object will execute a start command at the Temperature Override level of start/stop command priority, unless changed by the user.

k. Composite Object: Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphic shell of this container.

7. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). Provide the following as part of the standard library included with the programming software:

a. LonMark/LonWorks Devices: These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. Support all network variables defined in the LonMark profile. The device manufacturer shall provide information (type and function) regarding network variables not defined in the LonMark profile.
b. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file, and documentation for the device to facilitate device integration.
c. For BACnet devices, provide the following objects:

1) Analog In.
2) Analog Out.
3) Analog Value.
4) Binary.
5) Binary In.
6) Binary Out.
7) Binary Value.
8) Multi-State In.
9) Multi-State Out.
10) Multi-State Value.
11) Schedule Export.
12) Calendar Export.
13) Trend Export.
14) Device.

d. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
e. For BACnet devices, provide the following support at a minimum:

1) Segmentation.
2) Segmented Request.
3) Segmented Response.
4) Application Services.
5) Read Property.
6) Read Property Multiple.
7) Write Property.

8) Write Property Multiple.
9) Confirmed Event Notification.
10) Unconfirmed Event Notification.
11) Acknowledge Alarm.
12) Get Alarm Summary.
13) Who-has.
14) I-have.
15) Who-is.
16) I-am.
17) Subscribe COV.
18) Confirmed COV notification.
19) Unconfirmed COV notification.
20) Media Types.
21) Ethernet.
22) BACnet IP Annex J.
23) MSTP.
24) BACnet Broadcast Management Device (BBMD) function.
25) Routing.

## 2.7 TERMINAL AIR BOX (TAB) CONTROLLERS

A. FMCS Volume Controller: Electronic, furnished and installed by TCC. Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. and shall be accurate down to 0.004" velocity pressure. Provide velocity and static sensor at box inlet for use by unit controller. Set boxes for maximum and minimum settings shown on the drawings. Refer to Section 23 36 00 for additional information.

B. The controller shall support various digital and analog inputs and outputs as needed for damper control, control valves, electric coils, airflow sensors, remote heating, occupancy sensors, etc. and shall be capable of independent occupancy scheduling.

C. Controller shall provide continuous zone temperature histories internal to device for up to 24 hours and perform its own limit and status monitoring and alarms to limit unnecessary communications.

D. Operator interface to any ASC point data or programs shall be through network resident programs or portable operator's terminal connected to the specific controller.

E. Store all system setpoints, proportional bands, control algorithms, and other programmable parameters such that a power failure of any duration does not necessitate reprogramming of the controller.

F. BACnet TAB controllers shall either be B-AAC devices or B-ASC devices as required to meet the performance and BTL listing.

## 2.8 DATA COLLECTION AND STORAGE (TRENDING REQUIREMENTS)

A. The NAC shall be able to collect data for any property of any object and store resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.
2. For interval logs, configure the object for time of day, day of week and the sample collection interval.
3. For deviation logs, configure the object for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full or rollover the data on a first-in, first-out basis.
5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

B. Store all log data in a relational database in the NAC that is accessible from a server (if the system is so configured) or a standard Web browser.

C. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

D. All log data shall be available to the user in ALL the following data formats:

1. HTML.
2. XML.
3. Plain text.
4. Comma or tab separated values.

E. The NAC shall archive its log data either locally (to itself) or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties:

1. Archive on time of day.
2. Archive on user-defined number of data stores in the log (buffer size).
3. Archive when log has reached its user-defined capacity of data stores.
4. Provide ability to clear logs once archived.

## 2.9 AUDIT LOG

A. Provide and maintain an audit log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date.
2. User ID.
3. Change or activity: i.e., change setpoint, add or delete objects, commands, etc.

## 2.10 DATABASE BACKUP AND STORAGE

A. The NAC shall automatically backup its database on a user-defined time interval.

B. Store copies of the current database and, at the most, the recently saved database in the NAC. The age of the most recently saved database shall depend on the user-defined database save interval.

C. Store the NAC database in XML format to allow viewing and editing. Other formats are acceptable as long as XML format is supported.

## 2.11 GRAPHIC USER INTERFACE SOFTWARE

A. Operating System:

1. Provide computer with the most current Microsoft-based operating system with which the GUI has proven compatibility.

B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu pulldowns and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line) that displays the location and the selected object identification.

C. Point Organization: Organize points by equipment categories, location, or other means acceptable to Owner.

D. Real-Time Displays: The GUI shall support the following graphic features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file. Use of proprietary graphic file formats is not acceptable. In addition to, or in lieu of, a graphic background, the GUI shall support the use of scanned pictures.
2. Graphic screens shall be able to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URLs, and links to other graphic screens.
3. Graphics shall support layering, and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
4. Modifying common application objects, such as schedules, calendars, and setpoints, shall be accomplished graphically.

    a. Schedule times shall be adjusted using a graphic slider without requiring any keyboard entry from the operator.
    b. Holidays shall be set by using a graphic calendar without requiring any keyboard entry from the operator.

5. Commands to start and stop binary objects shall be made by selecting the object and the appropriate command from a pop-up menu. No text entry shall be required.
6. Adjustments to analog objects, such as setpoints, shall be made by selecting the object and using a graphic slider to adjust the value. No text entry shall be required.

E. System Configuration: At a minimum, the GUI shall include the necessary software and components to enable the operator to perform the following tasks with proper password access:

1. Create, delete or modify control strategies.
2. Add/delete objects.
3. Tune control loops by adjusting control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select alarm points and define the alarm state.
7. Select points to be trended and initiate the recording of values automatically.
8. View any trend as a graph.

F. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available using hypertext. All system documentation and help files shall be in HTML format.

G. Security: Each operator shall be required to log on to that system with a user name and password to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall be able to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall be automatically logged off the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. Store all system security data in an encrypted format.

H. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. Annunciate the failure of any device to the operator.

I. Alarm Console:

1. The system shall have a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and to acknowledge the alarm.
2. When the alarm console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator are not acceptable. The use of the alarm console can be enabled or disabled by the system administrator.

## 2.12 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser. Systems requiring additional software to enable a standard Web browser to reside on the client machine, or manufacturer-specific browsers, are not acceptable.

B. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphic User Interface. Systems that require different views or that require different means of interacting with objects, such as schedules or logs, are not permitted.

C. The Web browser client shall provide:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, display a blank web page. Implement security using Java authentication and encryption techniques to prevent unauthorized access.
2. Graphic screens developed for the GUI shall be the same screens used for the Web browser client. The web browser interface shall support all animated graphic objects supported by the GUI.
3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
4. Store all graphic screens in the Network Area Controller (NAC) without requiring any graphics storage on the client machine.
5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

    a. Modify common application objects, such as schedules, calendars, and setpoints, graphically.

        1) Schedule times shall be adjustable using a graphic slider, without requiring any keyboard entry from the operator.
        2) Holidays shall be set using a graphic calendar, without requiring any keyboard entry from the operator.

    b. Commands to start and stop binary objects shall be made by right-clicking the selected object and selecting the appropriate command from a pop-up menu. No text entry shall be required.
    c. View logs and charts.
    d. View and acknowledge alarms.
    e. Setup and execute SQL queries on log and archive information

7. The system shall be able to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just his/her defined home page. From the home page, links to other views or pages in the system shall be possible, if allowed by the system administrator.

8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on intranet sites by specifying the Uniform Resource Locator (URL) for the desired link.

## 2.13 SERVER FUNCTIONS AND HARDWARE

A. Provide a central server located in Server Room>. The server shall support all NACs connected to the customer's network whether local or remote.

B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1, or dial-up connection.

C. It shall be possible to provide access to all NACs via a single connection to the server. In this configuration, each NAC can be accessed from a remote GUI or from a standard WBI by connecting to the server.

D. The server shall provide the following functions:

1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
3. The server shall include a master clock service for its subsystems and provide time synchronization for all NACs.
4. The server shall accept time synchronization messages from trusted precision atomic clock Internet sites and update its master clock based on this data.
5. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.
6. The server shall provide demand limiting that operates across all NACs. The server must be capable of running multiple demand programs for sites with multiple meters and/or multiple sources of energy. Each demand program shall be able to support separate demand shed lists.
7. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to NACs.
8. Each NAC supported by the server shall be able to automatically archive its log data, alarm data and database to the server. Archiving options shall be user-defined, including archive time and archive frequency.
9. The server shall provide central alarm management for all NACs supported by the server. Alarm management shall include:

    a. Routing alarms to display, printer, e-mail, and pagers.
    b. Viewing and acknowledging alarms.
    c. Querying alarm logs based on user-defined parameters.

10. The server shall provide central management of log data for all NACs supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:

a. Viewing and printing log data.
b. Exporting log data to other software applications.
c. Querying log data based on user-defined parameters.

11. Reports shall be generated automatically or manually, and directed to LCD displays, printers, or disk files. The system shall allow the user to easily obtain the following types of reports:

a. List all points in network.
b. List all points in alarm.
c. List all off-line points.
d. List all points in override status.
e. List all disabled points.
f. List all points that are locked out.
g. List all items defined in a "follow-up" file.
h. List all weekly and holiday schedules.
i. List all limits and deadbands.

E. Server Hardware Requirements:

1. Provide a High-Mid Range CPU as defined by www.cpubenchmark.net (with Intel or AMD processor and SSD hard drive of at least 1-terabyte minimum hard drive and 16.0 GB RAM). It shall include one parallel port, one asynchronous serial port and four USB ports. Include a 21" minimum flat panel color monitor, 8ms response time.
2. The server operating system shall be the latest version of Microsoft Windows and Microsoft internet browser.
3. Connect to the FMCS network via an Ethernet network interface card, 1 Gbps.
4. Provide a color laser printer with a minimum 600 x 600-dpi resolution and 12 ppm print speed.
5. For dedicated alarm printing, provide a continuous feed printer using roll or fan-fed microperforated paper. The printer shall have a parallel port interface.

## 2.14 GRAPHIC USER INTERFACE COMPUTER HARDWARE (LAPTOP COMPUTER)

A. Provide a High-Mid Range CPU as defined by www.cpubenchmark.net with Intel or AMD proccesor and SSD hard drive of at least 1-terabyte minimum hard drive and 16.0 GB RAM. Laptop computer shall be equipped with minimum 15" screen.

B. The workstation operating system shall be the latest version of Microsoft Windows and Microsoft internet browser.

C. Connect to the FMCS network via a 10/100 Mbps Ethernet network interface card.

D. Provide a color laser system printer with a minimum 600 x 600-dpi resolution and 12 ppm print speed.

## 2.15 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. A UPS shall be provided for each of the following:

1. FMCS workstations and servers.
2. Network area controllers.
3. Chiller plant manager (including refrigerant monitor).
4. Boiler plant manager.

B. Provide a 120-volt 60 Hz line-interactive uninterruptible power supply with backup battery capacity for two (2) minutes at 100% load. UPS shall have hot swappable batteries, automatic battery self-test and start-on-battery capabilities. Batteries shall be valve regulated, sealed lead acid type. UPS shall have sine wave shape output waveform. UPS shall be UL 1778 list and comply with FCC Part 15, Class A.

C. Manufacturers:

1. Sola/Hevi-Duty
2. Eaton Powerware
3. APC

## 2.16 SYSTEM PROGRAMMING

A. The GUI software shall perform system programming and graphic display engineering. Access to the GUI software shall be through password access as assigned by the system administrator.

B. Provide a library of control, application, and graphic objects to enable creation of all applications and user interface screens. Applications shall be created by selecting the control objects from the library, dragging or pasting them on the screen, and linking them together using a built-in graphic connection tool. Completed applications may be stored in the library for future use. GUI screens shall be created in the same fashion. Data for the user displays shall be obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Provide all software tools or processes to create applications and user interface displays.

C. Programming Methods:

1. Provide the capability to copy objects from the supplied libraries or from a user-defined library to the user's application. Link objects with a graphic linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; e.g., internal, external, hardware, etc.

2. Configuration of each object shall be done through the object's property sheet using fill-in-the-blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration is not acceptable.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. All programming shall be done in real time. Systems requiring the uploading, editing, and downloading of database objects are not allowed.
5. The system shall support object duplication in a customer's database. An application, once configured, can be copied and pasted for easy reuse and duplication. All links, other than to the hardware, shall be maintained during duplication.

## 2.17 DDE DEVICE INTEGRATION

A. The NAC shall support the integration of device data via Dynamic Data Exchange (DDE) over the Ethernet network. The NAC shall act as a DDE client to another software application that functions as a DDE server.

B. Provide the required objects in the library included with the Graphic User Interface programming software to support the integration of these devices into the FMCS. Objects provided shall include, at a minimum:

1. DDE Generic AI Object.
2. DDE Generic AO Object.
3. DDE Generic BO Object.
4. DDE Generic BI Object.

## 2.18 MODBUS SYSTEM INTEGRATION

A. The NAC shall support integration of device data from Modbus RTU, ASCII, and TCP control system devices. Connect to the Modbus system via an RS-232, RS485, or Ethernet IP as required by the device.

B. Provide the required objects in the library included with the GUI programming software to support the integration of the Modbus system data into the FMCS. Objects provided shall include, at a minimum:

1. Read/Write Modbus AI Registers.
2. Read/Write Modbus AO Registers.
3. Read/Write Modbus BI Registers.
4. Read/Write Modbus BO Registers.

C. The NAC shall perform all scheduling, alarming, logging and global supervisory control functions of the Modbus system devices.

D. The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment using Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning.

## 2.19 SOFTWARE

A. IDC/IBCs shall operate totally standalone and independent of a central computer for all specified control applications.

B. Software shall include a complete operating system (OS), communications handler, point processing, energy management application packages as specified herein, standard control algorithms and specific control sequences (IDC/IBC) and an Owner/user custom control calculation package complete with interpreter.

C. OS software shall be PROM resident, operate in real time, provide prioritized task scheduling, control time programs, monitor and manage communications, and scan inputs and outputs.

D. Each IDC/IBC panel shall include the following energy management routines:

1. Time of day scheduling.
2. Optimum start/stop.
3. Peak demand limiting.
4. Economizer control.
5. PID control.
6. Supply air reset.
7. Outdoor air reset.

E. Input/output point processing software shall include:

1. Update of all connected input and output points at least once per second.
2. Analog to digital conversion, scaling and offset, correction of sensor non-linearity, sensing no response or failed sensors, and conversion of values to 32-bit floating point format. Retain both the maximum and minimum values sensed for each analog input in memory. It shall be possible to input subsets of standard sensor ranges to the A/D converter and assign gains to match the full-scale 32-bit conversion to achieve high accuracy readout.
3. A reasonability check on all analog inputs against previous values and discarding of values falling outside preprogrammed reasonability limits.
4. Assignment of proper engineering units and status conditions to all inputs and outputs.
5. Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and alarm) to an input or to assign a set of floating limits (alarm a reset schedule or FMCS control point) to the input. Assign each alarm a unique differential to prevent a point from oscillating in and out of alarm. Make alarm comparisons of each scan cycle.
6. Adjustment of timing from two seconds to two minutes in one-second increments to eliminate nuisance alarms on startup.

F. Command Control software shall manage the receipt of commands from the server and from control programs.

1. Provide command delay to prevent simultaneous energizing of loads. Delay must be programmable from 0 to 30 seconds.
2. Assign each command a command and residual priority to manage conflicts created by multiple programs having access to the same command point. Allow only outputs with a higher command priority to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
3. A "fixed mode" option (override) shall allow inputs to and outputs from control programs to set to a fixed state or value. When in the "fixed mode", assign inputs and outputs high residual command priority to prevent override by application programs.

G. Alarm lockout software shall prevent nuisance alarms. On initial start-up of mechanical equipment, assign a "timed lockout" period to analog points to allow them to reach a stable condition before activating alarm comparison logic. Lockout period shall be programmable for each point from 0 to 90 minutes in one-minute increments.

H. A "hard lockout" shall also be provided to positively lock out alarms when equipment is turned off or when a true alarm depends on the condition of an associated point. Hard lockout points and lockout initiators shall be operator programmable.

I. Runtime shall be accumulated based on the status of a digital input point. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Runtime counts shall reside in non-volatile memory and have DCP resident runtime limits assignable through the operator's terminal.

J. A transition counter shall count the number of times a device is cycled on or off. Counter shall be non-volatile and capable of counting 600,000 cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.

K. Custom IDC/IBC programs shall meet the control strategies called for in the sequence of operation of these specifications. Each IDC/IBC shall have resident in its memory and available to the programs a full library of IDC/IBC algorithms, intrinsic control operators, arithmetic, logic, and relational operators. Provide the following features:

1. Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self-learning). Use Adaptive Control where the controlled flow rate is variable (such as TAB units and variable flow pumping loops). The adaptive control algorithm shall monitor the loop response to output corrections and adjust the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of the system dynamics so that, on system shutdown and restart, the learning process starts from where it left off. Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.

2. All IDC/IBC setpoints, gains and time constants associated with IDC/IBC programs shall be available to the operator for display and modification via the operator workstation.
3. The execution interval of each IDC/IBC loop shall be adjustable from 2 to 120 seconds in one-second increments.
4. IDC/IBC control programs shall assign initialization values to all outputs so controlled devices assume a failsafe position on start-up.

L. Provide time and event programming (TEP) capability to initiate a controlled sequence of events for execution at a specific time or upon the occurrence of an event. Minimum program features required are:

1. Analog points commandable to a specific value.
2. Digital points commandable to a specific state; e.g. on or off; fast, slow or off.
3. Initiator to be a specific day and time or a specific event; e.g. an alarm.
4. Manual initiation via operator's command.
5. Commands must honor command delays (to prevent current surges), and assigned minimum ON and OFF times.
6. Commands must honor command and residual priority structures allowing higher priority commands (like smoke control) to override lower priority commands (like time of day scheduling) and residual priority.
7. Ability to chain TEPs.
8. Ability to enable and disable TEPs individually.
9. Ability to enable/disable TEP initiators.

M. Store Energy Management application programs and associated data files in non-volatile or 72-hour battery backed RAM memory. Individual programs shall be accessible from the operator workstation for enabling/disabling and program parameter modification and shall include:

1. Time Programs:

   a. Provide an independent start and stop program time for each system identified in the points list.
   b. It shall be possible to assign two independent start and stop times/days to any equipment connected to a controller.

2. Exception Day Scheduling:

   a. Provide an Exception Day program for holiday and other planned exceptions to time programs. Exception schedules shall be DSC resident and operator programmable up to one year in advance.
   b. The program shall allow definition of up to 32 exception time spans. Define each span by calendar start day and calendar stop day.

3. An IDC/IBC resident temporary scheduler shall allow operators to modify present time program control of equipment. Minimum feature set required is:

   a. Ability to alter time schedules as much as six days in advance.
   b. Ability to alter either start time, stop time or both for each day.
   c. Temporary schedule shall be in effect for all days specified.

d. Automatically delete the temporary schedule and restore program to normal schedule after execution.
e. Ability to assign schedule changes as permanent as well as temporary.

N. The IDC/IBC shall have built-in, non-descriptive, self-test procedure for checking the indication lights, digital display, and memory. It shall display advisories for maintenance, performance, and/or software problems.

O. All electronics shall be:

1. Standard locally stocked modular boards.
2. Plug-in type.
3. Furnish all ROM programs unlocked.

## 2.20 VARIABLE FREQUENCY DRIVES

A. The following variable frequency drives shall be furnished and installed by the TCC:

1. All project VFDs
2.

B. Refer to Section 23 05 15 Variable Frequency Drives for additional information.

C. Power connection between VFD and motor shall be by EC. Coordinate feeder and raceway installation with EE.

## 2.21 CONTROL DAMPERS

A. Rectangular Control Dampers - Standard Construction:

1. Shall be licensed to bear the AMCA Certified Rating Seal.
2. Test leakage and pressure drop per AMCA 500.
3. Frame: Hat-shaped channel, minimum 12 gauge extruded aluminum, and minimum 4" deep. Caulk or weld seams to prevent leakage.
4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, and overlapping blades and blade seals (overlapping blade seals only is unacceptable).
5. Shaft: Non-cylindrical, solid aluminum or zinc plated steel with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
7. Blade Seals: Extruded silicone gaskets secured in an integral slot within the blade.
8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.

9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
11. Maximum Leakage: Class 1A at 1" w.c. pressure differential for a 24" x 24" damper.
12. Maximum Pressure Drop for Opposed Blade Damper: 0.15" for 8000 CFM through a 24" x 24" damper (2000 fpm).
13. Maximum Pressure Drop for Parallel Blade Damper: 0.08" for 8000 CFM through a 24" x 24" damper (2000 fpm).

B. Thermally Insulated Control Damper:

1. Shall be licensed to bear the AMCA Certified Rating Seal.
2. Test leakage and pressure drop per AMCA 500.
3. Frame: Extruded aluminum, minimum 4" deep, 0.080" minimum thickness.
4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, internally insulated with expanded polyurethane foam and thermally broken, with overlapping blades and blade seals (overlapping blade seals only is unacceptable).
5. Shaft: Non-cylindrical, solid aluminum or zinc plated steel shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
7. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.
8. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
9. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
10. Maximum Leakage: Class 1A at 1" w.c. pressure differential for a 24" x 24" damper.
11. Maximum Pressure Drop: 0.21" for 8000 CFM through a 24" x 24" damper (2000 fpm).

C. Round Galvanized Steel Control Dampers:

1. Test leakage and pressure drop per AMCA 500.
2. Frame: Minimum 20 gauge galvanized steel, 10" long.
3. Bearings: Provide thrust bearings for vertical damper applications.

4. Blades: Two-layer galvanized steel, equivalent 14 gauge thickness with neoprene or polyethylene foam seal enclosed in two-piece blade construction up to 24", 10 gauge steel over 24".
5. Linkage: Stainless steel, minimum 1/2" diameter shaft through 24", 3/4" shaft over 24" size. Stainless steel bearings. Shaft shall be securely keyed to blades and of sufficient length to mount direct-coupled actuator. Install damper with the shaft horizontal to the floor. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
6. Maximum Leakage: 8 CFM maximum at 1" w.c. pressure differential for a 24" x 24" damper.
7. Maximum Pressure Drop: 0.10" for 6280 CFM through a 24" damper (2000 fpm).

## 2.22 DAMPER ACTUATORS

A. Damper Actuators - Electronic:

1. Actuator shall be UL 873 or 60730 listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation. Mount actuator by means of a V-bolt dual nut clamp with a V-shaped toothed cradle, directly couple and mount to the valve bonnet stem, or ISO-style direct-coupled mounting pad. Actuators shall be capable of being mechanically and electrically paralleled to increase torque, if required.
2. Actuators shall be warranted for a period of five (5) years from the date of production, with the first two (2) years unconditional.
3. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.
4. Fail-Safe Dampers: Where shown on the drawings or sequences, fail-safe mechanism shall operate the damper to the fail position following power interruption.

    a. Mechanical/Spring: Mechanical spring return mechanism to drive controlled drive to an end position (open or close) on loss of power.
    b. Electronic: Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the capacitors. The power fail position shall be proportionally adjustable between 0% and 100% in 10 percent increments with a 10 second operational delay.
5. Feedback: Where shown on drawings or sequences, provide analog feedback signal for positive position indication.
6. Damper End Switches: Where shown on the drawings or sequences, provide end switches to prove damper reaches open/closed position.

## 2.23 HYDRONIC CONTROL VALVES

A. General:

1. Two-position valves shall be a minimum of line size with a maximum allowable pressure drop of 1 psi.

2. Size two-way and three-way modulating valves to provide a pressure drop at full flow of 4 to 5 psi, except boiler three-way and cooling tower bypass valves shall not have a pressure drop over 4 psi.
3. Modulating two-way valves shall have equal percentage flow characteristics.
4. Modulating three-way valves shall have linear flow characteristics.
5. Piping geometry correction factors for $C_v$ ratings shall be used and stated for ball valves, butterfly valves, or non-characterized valves.

B. Two-position:

1. Ball 2" and under:

a. Design Pressure: 400 psi

1) Design Temperature: 212F
2) Design Flow Differential Pressure Rating: 150 psi

b. Bronze or brass body, stainless steel stem, chrome plated brass or stainless steel full port ball, EPDM, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470F melting point of 95-5 solder).

2. Ball 3" to 6":

a. Design Pressure: 200 psi

1) Design Temperature: 212F
2) Design Flow Differential Pressure Rating: 35 psi

b. Cast iron body, stainless steel stem, stainless steel full port ball, EPDM, PTFE or RTFE seats and seals, flanged ends.

3. Butterfly 2-1/2" to 12":

a. Design Pressure: 125 psi

1) Design Temperature: -20F to 212F
2) Design Flow Differential Pressure Rating: 50 psi

b. Cast iron body, stainless steel stem with extended neck, aluminum-bronze or nickel-plated iron disc, EPDM seats and seals, fully lugged ends.

C. Modulating:

1. Globe 1/2" to 2":

a. Design Pressure: ANSI Class 250

1) Design Temperature: 280F
2) Design Flow Differential Pressure Rating: 35 psi
3) Leakage: ANSI Class VI

b. Bronze or brass body, trim and plug; stainless steel stem; stainless steel or bronze seat; EPDM, PTFE or RTFE packing; threaded ends.

2. Globe 2-1/2" to 6":

a. Design Pressure: 125 psi

1) Design Temperature: 250F
2) Design Flow Differential Pressure Rating: 25 psi
3) Leakage: ANSI Class III

b. Cast iron body, bronze or brass trim and plug; stainless steel stem; bronze seat; EPDM, PTFE or RTFE packing; flanged ends.

3. Ball 2" and under:

a. Design Pressure: 400 psi

1) Design Temperature: 250F
2) Design Flow Differential Pressure Rating: 35 psi
3) Leakage: 0%

b. Bronze or brass body, nickel plated brass or stainless steel stem, chrome plated brass or stainless steel ball, EPDM, PTFE or RTFE seats and seals, V-Port ball, screwed ends.

4. Ball 2-1/2" to 6":

a. Design Pressure: 200 psi

1) Design Temperature: 212F
2) Design Flow Differential Pressure Rating: 35 psi
3) Leakage: 0%

b. Cast iron body GG25, stainless steel stem, stainless steel ball, EPDM, PTFE or RTFE seats and seals, V-Port ball, flanged ends.

5. Butterfly 2-1/2" to 12":

a. Design Pressure: 125 psi

1) Design Temperature: -20F to 212F
2) Design Flow Differential Pressure Rating: 50 psi

b. Cast iron body, stainless steel stem with extended neck, aluminum-bronze or nickel-plated iron disc, EPDM seats and seals, fully lugged ends.

6. Pressure Independent Control Valves (PIC Valves or PICV) 3/4" and Smaller:

a. Design Pressure: 360 psi
b. Close-off Pressure: 75 psig
c. Design Temperature: Between 36F and 212F

d. Pressure independent operation up to system delta-p of 50 psid minimum; maximum pressure drop of 5.0 psid at design flow; 0% leakage; forged brass body; NPT female ends; stainless steel ball and stem, PTFE seats and dual EPDM seals.
e. Acceptable Manufacturers:

1) Flow Control Industries
2) Belimo
3) Danfoss

## 2.24 VALVE ACTUATORS

A. General:

1. Actuators shall be sized to operate the valve through its full range of motion and shall close against pump shutoff pressure without producing audible noise at any valve position.
2. Provide visual position indication.
3. Mount actuator directly on valve or provide linear motion assembly as required for valve type.

B. Valve Actuators - Electronic:

1. Actuator shall be UL 873 or 60730 listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation. Mount actuator by means of a V-bolt dual nut clamp with a V-shaped toothed cradle, directly couple and mount to the valve bonnet stem, or ISO-style direct-coupled mounting pad. Actuators shall be capable of being mechanically and electrically paralleled to increase torque, if required.
2. Actuators shall be warranted for a period of five (5) years from the date of production, with the first two (2) years unconditional.
3. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.
4. Fail-Safe Valves: Where shown on the drawings or sequences, fail-safe mechanism shall operate the valve to the fail position following power interruption.

a. Mechanical/Spring: Mechanical spring return mechanism to drive controlled drive to an end position (open or close) on loss of power.
b. Electronic: Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the capacitors. The power fail position shall be proportionally adjustable between 0% and 100% in 10 percent increments with a 10 second operational delay.

5. Feedback: Where shown on drawings or sequences, provide analog feedback signal for positive position indication.

## 2.25 CONTROL INSTRUMENTATION

A. Temperature Measuring Devices:

1. Electric Thermostats:

a. Single Temperature - Line Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5F, concealed temperature adjustment, locking cover, rated for load, single or double pole as required.
b. Single Temperature - Low Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5F, anticipator circuits, concealed temperature adjustment, locking cover, 24 V control transformer (if not included with unit under control), single or double pole as required.

2. Low Limit Switch:

a. Provide one foot of sensing element for each one square foot of coil area, maximum element length 25 feet, of the vapor tension type, so that any point along the entire length of measuring element can trigger the switch.
b. Provide 3" minimum radius capillary support clips at each turn.
c. Furnish each thermostat with one single pole, single throw normally-opened switch and one single pole, single throw normally-closed auxiliary switch.
d. Setpoint range shall be 15F to 55F, with a permanent stop at 35F.
e. Differential shall be fixed at approximately 5F and supplied with manual reset.

B. Temperature Sensors:

1. Room Temperature Sensor:

a. Sensor Only: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy, no setpoint adjustment or override button.
b. Sensor with Setpoint Adjustment: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy, with exposed single setpoint adjustment (no numeric temperature scale - provide with a single warmer/cooler or red/blue visual scale), no override button.
c. Sensor with Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy, occupied/unoccupied override button with LED, no setpoint adjustment.

d. Sensor with Setpoint Adjustment and Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy, with exposed single setpoint adjustment (no numeric temperature scale - provide with a warmer/cooler or red/blue visual scale), occupied/unoccupied override button with LED.

2. Duct Temperature Sensor:

a. RTD type averaging sensor. 1000 ohm platinum RTD; accuracy: minimum ± 1.2F; range -40F to 220F.
b. Sensing element shall have a minimum of 1 foot of sensor length for each 2 square feet of duct or coil area. Sensor shall be arranged evenly across the duct or coil such that no point in the duct or coil is more than 1 foot away from the sensor.
c. Probe type thermistors are acceptable in VAV box duct applications downstream of reheat coils.

3. Water Temperature Sensor:

a. RTD type. 1000 ohm platinum RTD; accuracy: minimum ± 0.65F; range -40F to 220F.
b. Thermowell: RTD must be installed within a 316 stainless steel thermowell using a non-hardening heat conducting paste. Thermowell shall be rated for a minimum static pressure of 500 psig at the maximum operating temperature and be capable of withstanding water velocities of up to 27 fps. The sensor shall be mounted so that it extends into the flow stream to a minimum of 1/3 of the diameter of the pipe. For pipes greater than 10 inch diameter, thermowell shall be installed in a position 45 degrees from the bottom of the pipe. Separate thermometers, as specified elsewhere, shall be installed within 2 feet of each temperature sensor.

C. Humidity Measuring Devices:

1. Humidity Sensors:

a. Room Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be ± 2% of reading.
b. Duct Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be ± 2% of reading.

2. Humidistats:

a. Room Humidistats: Wall-mounted, proportioning type, with adjustable 2% RH throttling range, operating range from 30% to 80% at temperatures up to 100F, cover with concealed setpoint. Accuracy shall be minimum of 1.5 %RH accuracy from 0-90 %RH and 2.5 %RH accuracy from 90-100 %RH at temperatures from 50F to 104F.
b. High Limit Duct Humidistat: 2-position insertion type, with differential maximum 2% RH.

3. Combination Room Temperature/Humidity Sensors:

    a. Wall-mounted two-piece construction, plastic enclosure, off-white color with temperature and humidity measurement, exposed single setpoint adjustment and occupant override. Large display with temperature and %RH readout display, occupied/unoccupied override button with LED.

    b. Temperature Component: Thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy.

    c. Humidity Component: Proportioning type, with adjustable 2% RH throttling range, operating range from 0% to 90% at temperatures up to 110F. Accuracy shall be minimum of 2.0 %RH accuracy from 0-90 %RH.

D. Enthalpy Sensors: Duct-mounted enthalpy sensor shall include solid state temperature and humidity sensors with electronics that shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling.

E. Pressure Measuring Devices

1. Differential Pressure Switches:

    a. Standard Pressure Switches:

        1) Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.
        2) Accuracy shall be ± 3% of full scale maximum throughout entire range at 70F.
        3) Provide mounting brackets, probes, and shutoff valves required for proper installation.
        4) The range and service shall be as required for application or as noted on the drawings.
        5) Provide two (2) photo-transistor-activated circuits and two (2) DPDT relays for both high or low limit alarms or controls.
        6) Provide latching relays that require manual reset once activated.
        7) Acceptable Manufacturer: Dwyer Photohelic Series 3000.

2. Pressure Transmitters/Transducer:

    a. Air-to-Air:

        1) Provide transducer having the following minimum performance for measuring duct static pressure for VFD control or measuring differential pressure across filter banks:

            a) Accuracy: ± 1.0% FS
            b) Non-Linearity, BFSL: ± 0.96% FS
            c) Hysteresis: 0.10% full scale
            d) Non-Repeatability: 0.05% full scale

e) Thermal Effects (compensated range): 0F to +150F
f) Maximum Line Pressure: 10 PSI
g) Zero/Span Shift: 0.033%FS/F
h) Long Term Stability: 0.5%FS/1year

b. Wet-to-Wet (uses include measuring hydronic system differential pressure for VFD control):

1) Unidirectional pressure range selected for appropriate range based on the application.
2) Provide transducer with minimum 250 psi high side proof pressure and minimum 60 psi low side proof pressure.
3) Case shall be constructed of stainless steel/aluminum and shall be equipped with 1/4" threaded connections. Wetted parts shall be constructed of 300 series stainless steel. Provide transducer with Viton and silicone O-rings for solutions containing water and/or glycol. Provide transducer with Buna-N O-rings for hydrocarbon solutions.
4) Provide transducer with factory assembled 3-valve manifold assembly to allow for field calibration of transducer.
5) Performance shall be as follows:

a) Accuracy: ± 0.25% F.S.
b) Non-Linearity: ± 0.20% F.S.
c) Hysteresis: 0.10%F.S.
d) Non-Repeatability: 0.05% F.S.
e) Compensated Temp Range: +30F to +150F
f) Long Term Stability: 0.5% F.S./year

F. Flow Measuring Devices:

1. Flow Switches:

a. Suitable for the intended application (water or air system).
b. Vane Operated Flow Switch: Vane motion shall activate a single pole, double throw snap switch.

| Area (sq.ft.) | Total # of Sensors Required |
|---|---|
| Less than 2 | 4 |
| 2 to less than 4 | 6 |
| 4 to less than 8 | 8 |
| 8 to less than 16 | 12 |
| ≥ 16 | 16 |

G. Current Measuring Devices:

1. Current Switches for Constant Speed Motors:

a. Digital device rated for amperage load of motor or device with split core design, adjustable high and low trip points, 600 VAC rms isolation, induced power from the monitored load, LED indicator lamps for output status and sensor power. The device shall sense overloading, belt-loss, and power failure with a single signal.

2. Current Switches for Motors Controlled by VFD:

a. Digital device rated for amperage load of motor or device with split core design, factory programmed to detect motor undercurrent conditions on variable or constant volume loads, self-calibrating, positive status indication, LED indicator lamps, 600 VAC rms isolation, induced power from the monitored load with NO output. The current sensor shall store the motor current operating parameters in non-volatile memory and have a pushbutton reset to clear the memory if the operating parameters change or the sensor is moved to another load. The device shall sense overloading, belt-loss, and power failure with a single signal. The sensor shall be mounted on the load side of variable frequency drives.

H. Occupancy Sensors:

1. Use auxiliary contacts on sensor provided and installed by the Electrical Contractor. Refer to electrical drawings for sensor location and specifications. Coordinate with Electrical Contractor.
2. Space Occupancy Initial Setting Schedule
3. Initial Time
4. Space Delay Setting
5. Classroom 10 minutes
6. Reception 20 minutes

I. Carbon Monoxide Sensors:

1. Provide 4-20 mA output from the sensor to the FMCS system.
2. Provide local alarm whenever carbon monoxide level exceeds 100 ppm.
3. It shall be compatible with BACnet network interface and shall input these values to the network area controller.
4. Install in accordance with OSHA requirements.
5. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer's recommendations.

J. Carbon Dioxide Sensors:

1. Microprocessor based non-dispersive infrared sensor with range of 0 to 2,000 ppm CO2 with ± 100 ppm accuracy, maximum drift (compensated) of ± 5% full scale in five years, VOC software and hardware sensing, duct mounting where applicable, 0-10V dc or 4-20 mA output directly proportional to ppm, adjustable alarm limit, membrane filter, and terminal block. The diffusion gas chamber in the sensor shall incorporate a reflective light pipe or wave guide surrounded by a gas permeable membrane that prevents particulate contamination of the sensor. Unit shall have selectable IAQ mode with output signal and sum of CO2 and VOC levels.

K. Miscellaneous Devices:

1. Application Specific Controller Power Supply:

a. For use with terminal air boxfan coil unit.
b. Provide multiple enclosures with the following accessories and components as required to provide 24VAC power to terminal air boxes, differential pressure monitors, damper actuators, valve actuators, and other components and devices as required.
c. NEMA-1 steel enclosures (12"x12"x6") with separate high and low voltage compartments and separate access covers.
d. Either one 300 VA power supply with three 100 VA Class 2 outputs, or one 500 VA power supply with five 100 VA Class 2 outputs.
e. Primary side shall receive 480/277/240/120 input to 24 VAC ungrounded, isolated output on the secondary side.
f. Each secondary output shall include a 4 amp breaker, on/off switch, and LED indicator. Terminal blocks shall accept 16-22 AWG wire.

2. Drain Pan Condensate Overflow Switch: Float with integral magnet overflow switch conforming to UL508. No standby power required.

L. Outdoor Weather Station:

1. Outdoor rated ventilated plastic enclosure, off-white color, radiation shield including the following parameters.
2. Measured Parameters:

a. Temperature Sensor: Thermistor sensing element or resistance temperature device (RTD).

1) Operating Range: -40F to 140F
2) Accuracy: ± 0.54F at 68F

b. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service.

1) Measurement Range: 0-100% RH
2) Accuracy:

a) ± 3% of reading from 0%-90% RH at 50F to 86F
b) ± 5% of reading from 0%-90% RH at -4F to 50F and 86F to 140F

3. Calculated Parameters:

a. Dew Point Temperature in F
b. Wet Bulb Temperature in F
c. Enthalpy. Enthalpy sensor shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling.

2.26 CONDUIT AND BOXES

A. Conduit and Boxes: Refer to Electrical Section 26 05 33 for materials, sizing, and other requirements

B. Conduit and Box Identification (Color and Labeling):

1. Refer to Electrical Section 26 05 53 for raceway and box labeling requirements.

2.27 WIRE AND CABLE

A. Wire and Cable: Refer to Electrical Section 26 05 13 for wire and cable materials.

**PART 3 - EXECUTION**

3.1 GENERAL INSTALLATION

A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.

B. Install system and materials in accordance with manufacturer's instructions.

C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to meet the intent of the project documents shall be furnished and installed without additional cost.

D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.

E. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed ADA mounting requirements.

F. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other controls.

G. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.

H. After completion of installation, test and adjust control equipment.

I. Check calibration of instruments. Recalibrate or replace.

J. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.

K. All controls associated with the proper operation of air handling units, pumps, or other mechanical equipment served by emergency power shall be connected to the emergency power system. Control components shall be powered from the equipment branchoptional standby branch of emergency power. In no instance shall panel be connected to the life safety or critical branch of the emergency power system. Panels may be connected to a common 20 amp, 120 volt circuit provided the total load on the circuit does not exceed 16 amps. Circuit conductors shall be sized per the table below. All power connections to the control panels shall be performed by a licensed electrician at the cost of this Contractor. Submit circuit information (total amperage on circuit, conductors length, and panel) for control panels to the Architect/Engineer for approval.

| Circuit Load (Amps) | Circuit Max Length | Feeder Size |
|---|---|---|
| ≤ 5 | ≤ 200ft | 2#12 & 1#12 ground in 3/4" conduit. |
| ≤ 10 | ≤ 100ft | 2#12 & 1#12 ground in 3/4" conduit. |
| ≤ 16 | ≤ 75ft | 2#12 & 1#12 ground in 3/4" conduit. |
| ≤ 200 | ≤ 325ft | 2#10 & 1#10 ground in 3/4" conduit. |
| ≤ 100 | ≤ 160ft | 2#10 & 1#10 ground in 3/4" conduit. |
| ≤ 75 | ≤ 100ft | 2#10 & 1#10 ground in 3/4" conduit. |

L. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.

M. Labels For Control Devices:

1. Provide labels indicating service of all control devices in panels and other locations.
2. Labels may be made with permanent marking pen in the control panels if clearly legible.
3. Use engraved labels for items outside panel such as outside air thermostats.
4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.

N. VFDs:

1. This project includes several variable frequency drives to control the flow of fans and/or pumps based on a control variable.
2. If VFD has a bypass feature, auxiliary contacts on the drive may not be used for motor status. A separate relay must be used to indicate motor rotation in either hand or auto positions.
3. If a separate current transmitter or switch is indicated for status, install this device between the VFD and the motor. In this case, the drive status may be connected to the auxiliary contacts in the VFD.

4. Some devices, such as low limits and fire alarm shutdown relays, must be hardwired to the fan motor. Make connections such that fan will shut down whether in hand or auto position if the unit has a bypass feature.

O. Airflow Stations:

1. The transmitter shall be installed at a location that is protected from weather, water, and vibration.
2. Mount transmitter where they can easily be read (36" to 66" above floor). Do not fasten transmitters directly to ductwork or compromise duct insulation.
3. The manufacturer's authorized representative shall visit the project site during construction prior to station installations to confirm all submitted sizes, mounting requirements and locations. Size adjustments shall be made at no additional cost. The representative shall meet on site with the TCC to support and train them on proper installation procedures and calibration.
4. Install labels at each sensor and transmitter identifying its service.

## 3.2 GRAPHIC DISPLAY

A. Create a customized graphic for each piece of equipment indicated on the itemized points list.

B. Components shall be arranged on graphic as installed in the field.

C. Include each graphic point listed in the itemized points list using real time data.

D. Provide a graphic representation of the following:

1. Where there are multiple buildings, color code the campus map by the systems serving that building. The building graphic shall be linked to the graphic for that building's systems.
2. Where there are multiple floors, provide color codes/designations for the areas served by each AHU and TAB by floor.
3. Where multiple AHUs serve one floor, color code the areas served by each AHU. The area shall be linked to the graphic for that area's AHU.
4. Provide an overall floor plan of each floor of the building color coded by zone linked to the TAB for that zone. The zone shall be linked to the graphic for that zone's TAB graphic.
5. Show the location of each thermostat on the floor plan.
6. Provide separate graphics showing the chilled and heating water system flow diagram. Show temperatures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.
7. Provide a graphic showing the steam system flow diagram. Show pressures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.

E. The FMCS shall include full graphic operator interface to display the following graphics as a minimum:

1. Home page to include a minimum of six critical points: Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW, etc.
2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.
3. Detailed graphics for each mechanical system including AHUs, ERUs, EFs, chillers, and boilers, as a minimum.
4. Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.

F. The FMCS shall include individual graphical buttons to access the following data stored in PDF format:

1. Project control as-built documentation including all TCS drawings, diagrams and sequences of operation.
2. TCS Bill of Material for each system, e.g. AHU, RTU, FCU, boiler, etc.
3. Technical literature specification data sheets for all components listed in the TCS Bill of Material.

## 3.3 CONDUIT AND BOXES INSTALLATION

A. Conduit and Box Installation: Refer to Electrical Section 26 05 33 for execution and installation.

B. Conduit and Box Identification (color and labeling) installation. Refer to Electrical Section 26 05 53 for raceway and box identification installation.

C. Outlet Box Schedule: Thermostat/temperature sensor:

1. Dry Interior Locations: Provide 4" square galvanized steel with raised cover to fit flush with finished wall line. When located in concrete block walls, provide square edge title cover of sufficient depth to extend out to face of block or masonry boxes.
2. Other Conditions: Refer to Electrical Section 26 05 33 for requirements.

## 3.4 WIRE AND CABLE INSTALLATION

A. Wire and Cable Installation: Refer to Electrical Section 26 05 13 for execution and installation.

B. Field Quality Control:

1. Inspect wire and cable for physical damage and proper connection.
2. Torque test conductor connections and terminations to manufacturer's recommended values.
3. Perform continuity test on all conductors.
4. Protection of cable from foreign materials:

a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

C. Installation Schedule:

1. Conduit terminations to all devices installed in applications with rotating equipment, expansion/contraction or vibration shall be made with flexible metallic conduit, unless noted otherwise. Final terminations to exterior devices installed in damp or wet locations shall be made with liquidtight flexible metallic conduit. Terminations in hazardous areas, as defined in the National Electrical Code, shall be made with flexible conduit rated for the environment.

## 3.5 FMCS INSTALLATION

A. Coordinate voltage and ampacity of all contacts, relays, and terminal connections of equipment being monitored or controlled. Voltage and ampacity shall be compatible with equipment voltage and be rated for full ampacity of wiring or overcurrent protection of circuit controlled.

B. Naming Conventions: Coordinate all point naming conventions with Owner standards. In the absence of Owner standards, naming conventions shall use equipment designations shown on plans.

## 3.6 COMMISSIONING

A. Upon completion of the installation, this Contractor shall load all system software and start up the system. This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.

B. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the FMCS system operation.

C. This Contractor shall prove that the controls network is functioning correctly and within acceptable bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and statistics summary showing that each channel is within acceptable parameters. Each channel shall be shown to have at least 25% spare capacity for future expansion.

D. Upon completion of the performance tests described above, repeat these tests, point by point, as described in the validation log above in the presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

E. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

## 3.7 PREPARATION FOR BALANCING

A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).

B. Check the calibration and setpoints of all controllers.

C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.

D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum CFM.

E. Verify the operation of all interlock systems.

## 3.8 TEST AND BALANCE COORDINATION

A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

B. The Contractor shall provide a minimum of four (4) hours training for the Balancing Contractor in the use of these tools.

C. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process until the first 20 terminal units are balanced.

D. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

## 3.9 DEMONSTRATION AND ACCEPTANCE

A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

## 3.10 TRAINING

A. On-Site:

1. After completion of commissioning, the manufacturer shall provide 24 hours of training on consecutive days for 12 Owner's representatives. The training course shall enable the Owner's representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

B. Off-Site:

1. All classroom training shall be done using a network of working controllers representative of the installed hardware for this project.

C. Day-to-Day Operations - Training Description:

1. Proficiently operate the system.
2. Understand control system architecture and configuration.
3. Understand FMCS systems components.
4. Understand system operation, including FMCS system control and optimizing routines (algorithms).
5. Operate the workstation and peripherals.
6. Log-on and off the system.
7. Access graphics, point reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphic visual signals.

10. Understand system drawings and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from FMCS controllers and ASCs.
13. Operate portable operator's terminals.

D. Advanced Operations - Training Description:

1. Make and change graphics on the workstation.
2. Create, delete, and modify alarms, including annunciation and routing of these.
3. Create, delete and modify point trend logs and graph or print these both on and ad-hoc basis and at user-definable time intervals.
4. Create, delete, and modify reports.
5. Add, remove, and modify system's physical points.
6. Create, modify and delete programming.
7. Add panels when required.
8. Add operator interface stations.
9. Create, delete, and modify system displays, both graphic and others.
10. Perform FMCS system field checkout procedures.
11. Perform FMCS controller unit operation and maintenance procedures.
12. Perform workstation and peripheral operation and maintenance procedures.
13. Perform FMCS system diagnostic procedures.
14. Configure hardware including PC boards, switches, communication, and I/O points.
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
16. Adjust, calibrate, and replace system components.

E. System Management - Training Description:

1. Maintain software and prepare backups.
2. Interface with job-specific, third-party operator software.
3. Add new users and understand password security procedures.

F. Provide course outline and materials in accordance with the "SUBMITTALS" article in Part 1 of this section. The instructor(s) shall provide one copy of training material per student.

## 3.11 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight downward incline away from the sensor making a serpentine pattern over the cross-sectional area with elements spaced not over 12" apart and within 6" of the top and bottom of the area.

F. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

G. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated location approved by Architect/Engineer. TCC shall prime and paint the device enclosure. Color selection by Architect.

H. Install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

I. All hydronic differential pressure connections shall be made on the side of the pipe to prevent air or dirt from entering the gauge connection.

## 3.12 INSTALLATION OF FLOW METERS

A. Provide manufacturer's recommended lengths of straight piping upstream and downstream of the flow meter. Up to 30 diameters upstream of the flow meter may be required depending on the piping arrangement and flow meter type.

B. Maintain adequate pull/service space.

**END OF SECTION 230900**

**THIS PAGE INTENTIONALLY LEFT BLANK**

## SECTION 23 09 93 - BAS SEQUENCE OF OPERATIONS

## PART 1 - GENERAL

1.1 Related Sections

A. SECTION 23 09 00 BAS Instrumentation and Control for HVAC

## PART 2 - PRODUCTS

2.1 Not Applicable

## PART 3 - EXECUTION

3.1 GENERAL

A. Sequences specified herein indicate the functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.

B. When an air handling unit is not in operation, control devices shall remain in their "off" positions. "Off" positions may differ from the "normal" (meaning failed) position. Except as specified otherwise, "off" and "normal" positions of control devices shall be as follows:

| Device | "OFF" POSITION' | "NORMAL" POSITION |
|---|---|---|
| HEAT COIL VALVE | CONTROLLING | OPEN |
| COOLING COL VALVE | CLOSED | CLOSED |
| STEAM COIL VALVES | CLOSED | CLOSED |
| OUTSIDE AIR DAMPER | CLOSED | CLOSED |
| RETURN AIR DAMPER | OPEN | OPEN |
| EXHAUST/RELIEF DAMPER | CLOSED | CLOSED |

C. Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials shall be centered on the associated setpoint. All modulating feedback control loops shall include the capability of having proportional, integral, and derivative action. Unless the loop is specified "proportional only" or "P+I", Contractor shall apply appropriate elements of integral and derivative gain to each control loop which shall result in stable operation, minimum settling time, and shall maintain the primary variable within the specified maximum allowable variance.

D. Provide a real time clock and schedule controller with sufficient scheduling capability to schedule all required controllers and sequences. Set up initial schedules in coordination with Owner.

E. Scheduling Terminology: When air handlers are scheduled throughout the day, the following defines the terminology used:

1. Occupied Period: period of time when the building is in use and occupied. Generally systems will be fully operational throughout this period and ventilation air shall be continuously introduced. Space temperature setpoints will generally be in the "normal" range of 69°-77°F.
2. Unoccupied period: period of time when the building or zone is not in use and unoccupied. Ventilation air shall not be introduced.
3. Preoccupancy Period: Time prior to the Occupied period when the systems are returning the space temperatures from setback to "normal" or occupied setpoints (warm-up and cool-down). Ventilation air shall not be introduced unless outside air conditions permit free-cooling. Time period shall be determined by an optimum start strategy unless otherwise specified.
4. Setback Period: Setback will typically start with the end of the occupied period and end with the start of the preoccupancy period, however it shall be provided with its own schedule. Generally systems will be off except to maintain a "setback" temperature, economization may be enabled to maintain "setback" cooling setpoint when applicable.

F. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands shall be staggered by 5- second (adj.) intervals to minimize inrush current.

G. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper password level, from the Operator interface. For these points, it is unacceptable to have to modify programming statements to change the setpoint.

H. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated on the drawings, one of the following methods shall be employed:

1. Contractor shall determine a fixed reset schedule which shall result in stable operation and shall maintain the primary variable within the specified maximum allowable variance.
2. A floating reset algorithm shall be used which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance.
3. Primary variable shall control the devices directly using a PID feedback control loop without resetting the secondary variable. However, the control devices shall still modulate as necessary to maintain upper and lower limits on the secondary variable. Proportional band, integral gain, and derivative term shall be selected to maintain the primary variable within the specified maximum allowable tolerance while minimizing overshoot and settling time. Contractor shall gain prior approval for implementing this method of reset.

I. Where a supply air temperature or duct pressure setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, the following method shall be employed. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. space temperature) setpoint. The reset increment shall be determined by the quantity of "need heat" or "need cool" requests from individual SCU's. A SCU's "need heat"

virtual point shall activate whenever the zone's space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A SCU's "need cool" virtual point shall activate whenever the zone's space temperature rises above the currently applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values shall limit the setpoint range

J. Where a supply air temperature, duct pressure, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method shall be employed:

1. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. cooling valve, heating valve, damper position) setpoint of 85% open. The reset increment shall be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. The BAS analog output value shall be acceptable as indicating the position of the control device.
2. Alternatively to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the "need heat" or "need cool" virtual point shall increment by one unit each time a zone's valve/damper position rises to greater than 95% (adj.). The quantity of "need heat" or "need cool" points shall then be the basis for reset.

K. Where "prove operation" of a device (generally controlled by a digital output)is indicated in the sequence, it shall require that the BAS shall, after an adjustable time delay after the device is commanded to operate (feedback delay) , confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm shall be enunciated audibly. Upon failure, run command shall be removed and the device shall be locked out until the alarm is manually acknowledged unless specified otherwise.

L. BAS shall provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:

1. Speed control of variable speed drives
2. Control Reset Loop
3. Valve Travel Limit.

M. Wherever a value is indicated to be dependent on another value (i.e.: setpoint plus 5°F) BAS shall use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points shall be provided. One to store the parameter (5°F), one to store the setpoint, and one to store the value which is the result of the equation.

N. VSD Interface: BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be

displayed on a separate graphic that is selected from this system's graphic. Reference the VFD chart on the project plans for additional information on points that should be hard wired versus integrated through a direct interface.

O. Demand Limiting: The BAS shall broadcast the current demand level and adjust the current heating and cooling temperature setpoints as follows based on the current demand level:

1. Demand Level 0: The space temperature setpoints shall not be adjusted.
2. Demand Level 1: The heating setpoint shall be decreased by 1°F (adj.) & the cooling setpoint shall be increased by 1°F (adj.).
3. Demand Level 2: The heating setpoint shall be decreased by 2°F (adj.) & the cooling setpoint shall be increased by 2°F (adj.).
4. Demand Level 3: The heating setpoint shall be decreased by 3°F (adj.) & the cooling setpoint shall be increased by 3°F (adj.). 3.02

## 3.2 AIR HANDLING UNITS - GENERAL

A. **Logic Strategies:** The BAS shall fully control the air handlers. Generally the BAS shall energize the AH (start the fans and activate control loops) as dictated for each air handler. The following indicates when and how the BAS shall energize the AHs and control various common aspects of them. The following "logic strategies" shall be included by reference with each air handler with any specific clarifications required:

1. **Scheduled Occupancy:** BAS shall determine the occupancy periods (occupied, unoccupied, preoccupancy, and setback) as defined above. The following details the common control aspects related to the scheduled occupancy. The BAS shall display the applicable mode or "cause" for the unit operating. Reference the BAS control specifications (graphics) for more information on how this should be displayed.

    a. **Occupied Period:** BAS shall energize the AH during all occupied periods. Note that the beginning of the occupancy period shall be set sufficiently before the actual start of occupancy to obtain the required building component of ventilation per ASHREA 62. Specific times shall be as directed by the A/E. Minimum OA flow setpoint shall be as scheduled on the drawings. "Normal" setpoints shall apply.
    b. **Unoccupied Period:** Minimum OA flow shall be 0 CFM and the minimum OA damper position shall be 0%. If during the unoccupied period there is a request for occupancy override, the occupancy mode shall become active for an adjustable period. The unoccupied period and the preoccupancy period will typically overlap.
    c. **Setback Period:** the BAS shall deenergize the unit except as required to maintain a setback temperature as indicated in the individual sequences with a 5°F cycle differential. Generally, where setback temperatures apply in multiple zones, the worst zone shall control the system. Setback setpoints generally apply except during preoccupancy. If during the unoccupied period there is a request for occupancy override, the occupancy mode shall become active for an adjustable period. Generally, during heating setback, cooling shall be disabled. During cooling setback, both heating and cooling shall be enabled.
    d. **Preoccupancy:** BAS shall energize the AH continuously during the preoccupancy period. Minimum OA flow shall be 0 CFM or the minimum OA damper position shall be 0%. "Normal" space setpoints shall apply for the connected terminal units.

Preoccupancy duration shall be optimized so that the preset start time is minimized but all zones achieve setpoint at the start of the occupied period. The BAS shall continuously adjust to the preoccupancy period (up to a user defined maximum amount of time) to optimized the preoccupancy start period. Generally, during warm-up mode, cooling shall be disabled. During morning cooldown, both heating and cooling shall be enabled.

3.3 **Sequenced Heating and Cooling:** BAS shall control the heating and cooling coils and air side economizer as detailed for the particular AH. Program logic shall directly prohibit the heating and cooling valves as well as the heating valve and economizer damper to be open (or above minimum) simultaneously. This does not apply to cooling and reheat valves that are used simultaneously for dehumidification.

3.4 **Airside Economizer:** BAS shall modulate the mixing dampers to provide "free cooling" when conditions merit. The free cooling shall generally be staged before any mechanical cooling. While conditions merit, dampers shall be modulated in a DA PID loop to maintain mixed air temperature at a setpoint as specified for the individual unit. Economizer logic shall remain enabled during setback cooling, where applicable. Economizer mode shall be active while:

The unit is energized and status has been proven for at least 15seconds (adj.).
AND, when outside air temperature falls below the switching setpoint of 68°F (adj.), with 1°F (adj.) cycle differential.
AND, when outside air temperatures are above 45°F (adj.), with 1°F (adj.) cycle differential.
AND, when outside air enthalpy is less than 28 BTU/lb

A. **Mixed Air Low Limit Override:** BAS shall override the signal to the OA & RA dampers via a proportional only loop to maintain a minimum mixed air temperature. The maximum allowed output of the OA/RA dampers shall drop from 100% to 0% as the mixed air temperature drops from 47°F to 42°F (all values being adjustable).

B. **Freeze Safety:** Shall be provided by hardwired freeze stat with manual reset.

C. **Smoke/Fire Safety:** Upon indication of smoke or fire by the Fire Alarm system (via a relay provided by the FAS contractor), the BAS shall deenergize the AH via a hard wired interlock. All dampers shall revert to their normal "Off" positions unless specifically indicated otherwise. The BAS shall enunciate the appropriate alarm; then remove and lock out the unit start command until the alarm condition is cleared.

D. **High Pressure Safety:** Upon activation of a high pressure safety switch, AH shall be deenergized via a hard wired interlock and an indication of the operation shall be indicated at the BAS. The BAS shall enunciate the appropriate alarm; then remove and lock out the unit start command until the alarm condition is cleared.

E. **Demand Control Ventilation:** The OA damper shall modulate between minimum damper position and reduced minimum damper position based on combination of space CO2 sensors in training rooms and conference rooms and RA CO2 when economizer mode is not enabled. When economizer is enabled, it shall have priority over the damper position and CO2 control shall not be active. The minimum OA and reduced OA ventilation (50% of min OA) requirements shall be specified by the engineer, damper positions established by the air balancer, and BAS programmed by the BAS contractor. Engineer shall ensure that specified

minimum and reduced minimum damper position setpoints are adequate to maintain building pressure slightly positive at all times. The initial CO2 setpoint shall be 1000 ppm with a 400 ppm operating span. When the CO2 value is below theCO2 PPM setpoint as measured by the RA CO2 sensor for 60 min. (adj), the OA damper shall reset from "Minimum" position to the "Reduced Minimum" position. When the CO2 value is above the CO2 PPM setpoint (adj.) as measured by the RA CO2 sensor for 30 min. (adj.), the OA damper shall reset from "Reduced Minimum" to the "Minimum" position. If CO2 continues to rise the o/a shall be further opened in 10% increased o/a flows as measured by the outside air monitoring station every 15 minutes till setpoint is maintained. Upon a fall in CO2 below setpoint o/a shall return to minimum position. This is typically a "proportional only" control loop as the OA damper should not modulate until it's above or below setpoint. Economizer mode shall remain typical as a PI or PID Loop.

F. **Supply Air Static Pressure Reset Control:** Reset duct static pressure set point(s) higher or lower between maximum and minimum set points based on BAS optimization logic that uses the terminal unit air damper positions. The set point(s) shall be increased to maintain all dampers at less than 95% open. The set points(s) shall be decreased to maintain minimum of one damper at no less than 90% open. Initial and minimum setpoints shall be recommended by the TAB Contractor and approved by the Engineer. Maximum set points shall be equal to the initial setpoints plus 0.50 inches. Reset set point in 15 minute increments.

G. **Filter Pressure:** A differential pressure sensor across the filter shall be monitored and signal an alarm when pressure drop exceeds 1.0” (adj.)

The detailed “logic strategies” above shall be required by reference to the min each of the individual sequences specified below.

## 3.5 VAV AHU WITH PH & CHW COIL, RETURN FAN

A. **Supply Fan:** BAS shall control the starting and stopping of the supply fan as follows:

1. **Start/Stop:** BAS shall command the operation of the supply fan and it shall run continuously whenever the AH is “energized” as specified for the applicable logic strategies specified in item “Air Handling Units - General”.
2. **Proof:** BAS shall prove fan operation and use the status indication to accumulate runtime. Upon failure of the fan, BAS shall enunciate an alarm.
3. **VSD Control:** Whenever the fan is energized, BAS shall control the speed of the VSD to maintain the supply duct static pressure setpoint. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.
4. **VSD Interface:** BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system’s graphic. Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.
5. **Supply Duct Static Pressure Setpoint:**

**a.** Setpoint shall be reset between the limits of .5" to 2" as to maintain pressure requests of the VAV boxes with all values adjustable. Value shall be set by Test and Balance Sub Contractor.

**b.** BAS shall utilize a Sample and Bump output strategy or other similar loop output or logic to reset the static setpoint.

**c.** Reset values shall be adjusted for optimized building and energy performance.

B. Return **Fan:** BAS shall control the starting and stopping of the return fan as follows:

1. **Start/Stop:** BAS shall command the operation of the return fan and it shall run continuously whenever the AH is "energized" as specified for the applicable logic strategies specified in item "Air Handling Units - General" and the supply fan status has been proven on for at least 5 seconds(adj.).
2. **Proof:** BAS shall prove fan operation and use the status indication to accumulate runtime. Upon failure of the fan, BAS shall enunciate an alarm.
3. **VSD Control:** Whenever the fan is energized and the unit is operating in the Occupied mode, BAS shall control the speed of the VSD based on a tracking algorithm as defined below.

    a. TAB contractor shall determine the following 4 values:

        1) Supply Fan Max: The speed at which the supply fan will typically operate when all connected terminal units are at their maximum flow setpoints
        2) Supply Fan Min: The speed at which the supply fan will typically operate when all connected terminal units are at their minimum flow setpoints
        3) Return Fan Max: The speed at which the return fan will typically need to operate when all connected terminal units are at their maximum flow setpoints
        4) Return Fan Min: The speed at which the return fan will typically need to operate when all connected terminal units are at their minimum flow setpoints

    b. The BAS shall modulate the return fan speed as follows:

        1) When the speed of the supply fan is less than the Supply Fan Min value, the return fan speed shall be the output of a linear reset loop that is reset from 0% to the Return Fan Min value as the supply fan speed increases from 0% to the Supply Fan Min value.
        2) When the speed of the supply fan is greater than the Supply Fan Min value but not greater than the Supply Fan Max value, the return fan speed shall be the output of a linear reset loop that is reset from the Return Fan Min value to the Return Fan Max value as the supply fan speed increases from the Supply Fan Min value to the Supply Fan Max value
        3) When the speed of the supply fan is greater than the Supply Fan Max value, the return fan speed shall be the output of a linear reset loop that is reset from the Return Fan Max value to 100% as the supply fan speed increases from the Supply Fan Max value to 100%. Note that this stage will not apply if Supply Fan Max value or the Return Fan Max value equals 100%.
        4) The return fan speed shall be limited so that it is never commanded to a speed that is more than 20% (adj.) above or 20% (adj.) below the speed of the supply fan.

c. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.
d. During Unoccupied mode of operation, the Return Fan Speed shall be the same as the Supply Fan Speed.

4. **VSD Interface:** BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.

C. Outside Air (OA)/ Return Air (RA)/ Relief (Rel) Dampers: BAS shall control the dampers as follows:

1. **Closed:** When AH is deenergized, dampers shall remain in their "off" positions. When AH is energized during unoccupied period the minimum OA flow setpoint will be 0 cfm which will close the OA damper unless economizer is available.
2. **Minimum OA Control:** The OA damper shall modulate between minimum OA CFM and reduced minimum OA CFM based on combination of space CO2 sensors in training rooms and conference rooms and RA CO2 when economizer mode is not enabled. When economizer is enabled, it shall have priority over the OA CFM and CO2 control shall not be active. The minimum OA and reduced OA ventilation (50% of min OA) requirements shall be specified by the engineer, damper positions established by the air balancer, and BAS programmed by the BAS contractor. Engineer shall ensure that specified minimum and reduced minimum OA CFM setpoints are adequate to maintain building pressure slightly positive at all times. The initial CO2 setpoint shall be 1000 ppm with a 400 ppm operating span. When the CO2 value is below the CO2 PPM setpoint as measured by the RA CO2 sensor for 60 min. (adj), the OA damper shall reset from "Minimum" position to the "Reduced Minimum" position. When the CO2 value is above the CO2 PPM setpoint (adj.) as measured by the RA CO2 sensor for 30 min. (adj.), the OA damper shall reset from "Reduced Minimum" to the "Minimum" position. If CO2 continues to rise the o/a shall be further opened in 10% increased o/a flows as measured by the outside air monitoring station every 15 minutes till setpoint is maintained. Upon a fall in CO2 below setpoint o/a shall return to minimum position. This is typically a "proportional only" control loop as the OA damper should not modulate until it's above or below setpoint. Economizer mode shall remain typical as a PI or PID Loop. Do not enable the OAD control loop when OA temperature is less than 38°F and the HHW supply water temperature is less than 100°F.
3. **Relief Control:** BAS shall modulate the Rel damper to maintain the Relief plenum pressure at setpoint. Setpoint shall initially be set at 0.2"w.c. (adj.). 4.
4. **Economizer:** BAS shall modulate the OA/RA & Rel dampers per the Airside economizer strategy to maintain the mixed air temperature at setpoint. The mixed air setpoint shall be equal to the discharge air temperature setpoint (specified herein) minus 3°F (adj.). The dampers shall modulate open per the higher of the economizer PID loop output and:

a. The Minimum OA flow control output described above (for the OA& RA dampers only).
b. The Relief Control output described above (for the Rel Damper).

5. **Mixed Air Low Limit:** Per the mixed air low limit logic strategy, the OA and RA dampers' position shall be limited to prevent the mixed air temperature from falling below the low limit setpoint. The limit shall override the output from the economizer and minimum OA flow control loop outputs.

D. **Space Temperature Control:** The space temperatures shall be controlled via individual VAV boxes.

E. **Discharge Temperature Control:** The discharge temperature setpoint shall be set to the lower of the following:
1. The BAS shall utilize a Sample and Bump output strategy or other similar loop output/logic to calculate a resultant value based on the number of "need cooling" requests from associated VAV terminal units. The Upper and lower limits of this reset setpoint shall initially be set to 65°F and 58°F (both adjustable), respectively. The output of this loop shall input to a dehumidification loop as the high limit of its reset range (see below).
2. A dehumidification loop shall be A Proportional only loop output reset from the high limit output from the temperature reset loop (as described above) to 55°F (adj.) as the return air humidity or space humidity rises above 60% (both adjustable).
3. The resultant temperature output after passing through the two loops (as described above) shall be the effective discharge temperature setpoint. This value shall be trended, alarmed (vs actual temperature) and shown on the BAS graphic.
4. All reset values shall be adjusted for optimized building and energy performance.

F. Preheating Section:

**1.** **HW Heating Valve:** N.O. valve shall modulate per the higher of

a. a PID loop to maintain a leaving coil temperature at 52°F (adj.), and
b. a proportional only loop that is reset from 0 to 100% as the preheat air temperature drops from 48°F (adj.) to 40°F (adj.).
c. Heating Loops shall remain active even when the AHU is not enabled.

2. **Freeze Condition:** Whenever a freeze condition is initiated (as described in item "Air Handling Units – General – Freeze Safety", the HW valve shall be commanded to 100% open (adj.)

G. Cooling Section:

**1.** **Cooling Coil Valve:** Whenever the AHU is energized and status is proven ON, N.C. cooling coil valve shall modulate via a DA PID loop to maintain discharge temperature at setpoint.
**2.** During setback or morning warm-up modes, the ChW valve shall remain closed.
**3.** Whenever the unit is energized and the economizer mode is active, the chilled water valve shall remain closed unless the economizer dampers have been commanded to full open.
**4.** **Freeze Condition:** Whenever a freeze condition is initiated (as described in item "Air Handling Units – General – Freeze Safety", the ChW valve shall be commanded to 100% open (adj.)

**H.** **Occupancy Override:** When the Occupancy Override button on any of the room sensors is depressed momentarily, the unit shall be indexed to the Occupied period for 60 min. (adj.)

## 3.6 VAV DAMPER WITH REHEAT CONTROL

A. **General**: Control shall be pressure independent with minimum, maximum and heating maximum flow setpoints, scheduled occupancy with optimum preoccupancy.

B. **Space Temperature Control**: Four setpoints shall apply. Normal Heating (70°F adj.)), Normal Cooling (74°F adj.)), Setback Heating (65°F (adj.)), and setback cooling (80°F). These four values shall be the only values changed by the operator to adjust space temperature setpoint. All other dead bands, differentials, etc. shall be calculated in the program logic (unless another means is provided to prohibit overlap of the heating and cooling loops and ensure a dead band such as function block templates that restrict the setpoint input).

C. **Zone Damper**: Zone damper shall modulate in a PI loop to maintain zone volume setpoint. Zone volume setpoint shall be reset as follows based on the parent AHU Discharge Air Temperature:

1. Whenever the parent AHU DAT is < 65°F (adj.), the following sequence shall apply:

    a. Cooling: The zone volume setpoint shall be reset between the minimum and the cooling maximum volume settings to maintain the space temperature at the cooling space temperature setpoint via a PID loop output. The zone volume setpoint shall be reset linearly between the minimum and cooling maximum volume setpoints as the loop output increases from 0 to 100%.
    b. Heating: The zone volume setpoint shall be reset between the minimum and the heating maximum volume settings to maintain the space temperature at the heating space temperature setpoint via a PID loop output. Note that a common space heating PID loop output will be used to reset the zone volume setpoint (in the heating mode) and the HW reheat valve (see below). The zone volume setpoint shall be reset linearly between the minimum and heating maximum volume setpoints as the loop output increases from 25 to 100% (adj.).
    c. Dead band: When the space temperature is between the effective space temperature heating and cooling setpoints (heating and cooling PID outputs are both at 0%), the zone volume setpoint shall remain at the minimum flow setpoint.

2. Whenever the parent AHU DAT is > 65°F (adj.), the following sequence shall apply:

    a. Cooling: The zone volume setpoint shall remain at minimum whenever the space temperature is above the cooling setpoint as no cooling is available in this mode.
    b. Heating: The zone volume setpoint shall be reset between the minimum and the COOLING maximum volume settings to maintain the space temperature at the heating space temperature setpoint via a PID loop output. Note that a common space heating PID loop output will be used to reset the zone volume setpoint (in the heating mode) and the HW reheat valve (see below). The zone volume setpoint shall be reset linearly between the minimum and COOLING maximum volume setpoints as the loop output increases from 0 to 100% (adj.).
    c. Dead band: When the space temperature is between the effective space temperature heating and cooling setpoints (heating and cooling PID outputs are both at 0%), the zone volume setpoint shall remain at the minimum flow setpoint.

3. Zone Volume flow setpoints shall be as scheduled on the drawings.

D. **Hydronic Reheat:** Zone reheat coil valve shall modulate in a PID loop output (same loop output that resets the volume setpoint in the heating mode) to maintain the space temperature at the heating setpoint as defined above. The valve shall modulate from 0 to 100% on a PID loop output of 0-75% (adj.). The valve shall be closed whenever ALL the parent air units is off.

E. **Dehumidification:** When space relative humidity is greater than 60%, AHU supply air temperature shall be reset to 55°F. Hydronic reheat shall be used to maintain temperature setpoint to not overcool space.

F. **Static Pressure Request**: This terminal shall issue a "pressure request" as follows"

1. Whenever the damper output is > 95%, a pressure request shall be issued
2. Whenever the damper output falls below 75%, the pressure request shall stop

G. Reports:

1. Configure a tabular report using real-time data with the following column headings: VAV TERMINAL DESCRIPTION, ZONE TEMPERATURE, ZONE TEMPERATURE SETPOINT, PRIMARY AIR FLOW,PRIMARY AIR FLOW SETPOINT, DAMPER POSITION (0 to 100% open), REHEAT OUTPUT (0 to 100% heating), DISCHARGE AIR TEMPERATURE, ZONE HUMIDITY.
2. At the top of the table, list building number, floor or area description if applicable, parent air handling unit designation, air handling unit down duct static pressure and air handler discharge air temperature.
3. Reference the requirements for summary service screens in the Controls (graphics section) specification for additional information.

    a. Dead band: When the space temperature is between the effective space temperature heating and cooling setpoints (heating and cooling PID outputs are both at 0%), the zone volume setpoint shall remain at the minimum flow setpoint.

4. Zone Volume flow setpoints shall be as scheduled on the drawings.

## 3.7 FOUR-PIPE BLOWER COIL

A. **General:** The Building Automation System (BAS) shall send the controller Occupied Bypass, Morning Warm-up/Pre-Cool, Occupied/Unoccupied and Heat/Cool modes. If communication is lost with the BAS the controller shall operate using default modes and setpoints

B. **Occupied:** During occupied periods, the supply fan shall run continuously. The chilled water valve and the hot water valve shall control to maintain the active space temperature setpoint.

C. **Unoccupied:** When the space temperature is below the unoccupied heating setpoint of 60.0 deg. F (adj.) and hot water is detected, the supply fan shall start and the Heat/Cool water valve shall open. When the space temperature rises above the unoccupied heating setpoint of 60.0 deg. F (adj.) plus the unoccupied differential of 2.0 deg. F (adj.) the supply fan shall stop and the Heat/Cool water valve shall close. When the space temperature is above the unoccupied cooling setpoint of 80.0 deg. F (adj.) the supply fan shall start and the chilled water valve shall open. When the space temperature falls below the unoccupied cooling setpoint of 80.0 deg. F (adj.)

minus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop and the chilled water valve shall close.

D. **Optimal Start:** The BAS shall monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

E. **Morning Warm-Up Mode**: During optimal start, if the 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. When the space temperature reaches the occupied heating setpoint (adj.), the unit shall transition to the occupied mode.

F. **Pre-Cool Mode:** During optimal start, if the 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. When the space temperature reaches occupied cooling setpoint (adj.), the unit shall transition to the occupied mode.

G. **Optimal Stop:** 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.

H. **Occupied Bypass:** The BAS shall monitor the status of the ON and CANCEL buttons of the space temperature sensor. 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.).

I. **Space Temperature Control:** Cascade zone control shall be used in the occupied, occupied bypass, and occupied standby modes. It maintains zone temperature by controlling the discharge air temperature to control the zone temperature while minimizing the fan speed. The space temperature shall be maintained between the occupied cooling setpoint of 72.0 deg. F (adj.) and the occupied heating setpoint of 70.0 deg. F (adj.). The unit shall transition to the cooling mode when the space temperature rises one degree above the occupied cooling setpoint of 72.0 deg. F (adj.). The unit shall transition to the heating mode when the space temperature drops one degree below the occupied heating setpoint of 70.0 deg. F (adj.).

J. **Occupied Humidity Control:** Dehumidification mode shall terminate when the space relative humidity falls below the relative humidity setpoint minus the relative humidity offset. If the space relative humidity sensor fails the dehumidification sequence shall be terminated and an alarm shall annunciate at the BAS.

K. **Supply Fan Operation:** The supply fan shall cycle on demand during the unoccupied mode. When the controller transitions to the occupied mode, the supply fan shall start and run continuously.

L. **Condensate Overflow Monitoring:** If the condensate level reaches the trip point, a condensate overflow diagnostic shall annunciate at the BAS. To prevent the condensate drain pan from overflowing and causing water damage to the building the fan shall be disabled and the chilled water valve shall close.

M. **Filter Status**: A differential pressure switch shall monitor the differential pressure across the filter when the fan is running. If the switch closes during normal operation a dirty filter alarm shall annunciate at the BAS.

## 3.8 AIR COOLED CHILLER – PRIMARY/SECONDARY

A. **General:** BAS shall fully control the chilled water systems and equipment and provide monitoring and diagnostic information for management purposes. BAS shall interface directly with the chiller and all available points shall be monitored and displayed via the operator interface. Refer to the control diagram for additional information.

B. **Cooling Enable:** Cooling shall be enabled when any chilled water valve opens more than 20% continuously for 5 min. (adj.) and the outside air temperature is above 60°F (adj.). Once enabled, the chilled water system will operate for a minimum of 30 minutes or until OAT is below 58°F. The chilled water system shall also be enabled whenever manually enabled by the operator at the operator interface.

C. **Cooling Disable:** Cooling shall be disabled when all chilled water valves are less than 5% open continuously for 10 min. (adj.) or the outside air temperature is below 60°F. The chilled water system shall also be disabled whenever manually disabled by the operator at the operator interface.

**D. Secondary Pump Control**

1. Start/Stop: Whenever the system is enabled, at least one secondary chilled water pump shall be enabled to run continuously. Whenever the system is disabled, the secondary pumps shall be disabled after a 1 minute delay.

E. **Freeze Mode:** The secondary chilled water system shall be enabled for freeze protection whenever:

1. The OAT falls below 30°F (adj.)
2. OR, any AHU (or other unit) is tripped off due to a freeze condition (auto or manual reset).
3. This mode shall not cause the primary system to operate (i.e. chiller(s) are not enabled).

F. **Proof:** BAS shall prove pump operation and use the status indication to accumulate runtime. Upon failure of the lead system, the BAS shall enable the standby/lag system and enunciate an alarm. The BAS shall rotate the lead system on a regular basis (every 7 days – adj.) to equalize runtime.

G. **VSD Control:** Whenever a pump is energized and status is proven for at least one of the pumps, the BAS shall control the speed of the VSD to maintain the (lowest) differential pressure reading at setpoint. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.

H. **VSD Interface:** BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic. Reference the VFD

chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.

**I. Differential Pressure Setpoint:**

J. Setpoint shall be initially set at 15psi (adj.).

K. Setpoint shall be adjusted by the TAB contractor for optimized building and energy performance.

**L. Primary CHW Pump**

1. The primary pump shall be started via an output from the chiller controller whenever the associated chiller is enabled.
2. BAS shall monitor the pump status.
3. Pumps to circulate water when OAT below 30°F to prevent freezing.

## A. Chiller Control

4. Enable/Disable: Whenever the Chilled Water System is enabled, AND Either Secondary pump is proven the Chiller shall be enabled after a 1 minute delay (adj.).
5. Proof/ Failure assessment: Whenever the chiller is in alarm, the BAS shall enunciate an alarm. BAS shall assess the chiller to be in alarm if:

    a. chiller status is not proven ON in the first 10 minutes after the chiller is initially enabled.
    b. OR, any time the chiller alarm point is ON.

3.9 CONDENSING BOILER HW SYSTEM –PRIMARY / SECONDARY

A. **General**: BAS shall control the heating hot water system and equipment and provide monitoring and diagnostic information for management purposes. Boilers shall be interfaced such that loss of power from lead boiler will not cause operational issues for lag boiler.

B. **System Enable**: System shall be enabled whenever

1. manually selected to run by a manual command on the BAS
2. OR, the System Override Timer (local twist timer switch) is enabled
3. OR, the Outside Air Temperature is less than 38°F
4. OR, there is a call for the Heating System to run from any AHU or terminal unit for 10 minutes
5. OR, any AHU (or other unit) is tripped due to a freeze condition (auto or manual reset).
6. AND, the Emergency Stop Button is not enabled
7. AND, the system is not manually disabled by a command on the BAS.

C. **System Disable**: System shall be disabled whenever

1. the system is manually disabled by a command on the BAS
2. OR, the Emergency Stop Button is enabled

3. OR, the Outside Air Temperature is less than 50°F AND there is no call for the Heating System to run from any AHU or terminal unit for 5 minutes

D. Secondary Pump Control

1. **Start/Stop**: Whenever the system is enabled, at least one secondary hot water pump shall be enabled to run continuously.
2. **Proof**: BAS shall prove pump operation and use the status indication to accumulate runtime. Upon failure of the lead pump, the BAS shall enable the standby pump and enunciate an alarm. The BAS shall rotate the lead pump on a weekly basis (adjustable) to equalize runtime.
3. **VSD Control**: Whenever a pump is energized and status is proven for at least one of the pumps, the BAS shall control the speed of the VSD to maintain the differential pressure at setpoint. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.
4. **VSD Interface**: BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic. Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.
5. **Differential Pressure Setpoint:**

    a. Setpoint shall be initially set at 15psi (adj.).
    b. Setpoint shall be adjusted by the TAB contractor for optimized building and energy performance.

6. **Lead/Standby**: The BAS shall start the Standby pump as follows:

    a. Enable Standby Pump: Upon failure of the lead pump, the BAS shall enable the standby and enunciate an alarm. Pump rotation shall be advanced when standby pump is called to run.

E. E. Primary System Control

1. **Enable/Disable**: Whenever a primary system is requested by the BAS, the associated primary pump shall be enabled. When a primary system is disabled, the associated primary pump shall continue to run (for boiler pump down) for 2 minutes (adj).
2. **Proof**: BAS shall prove pump operation. Upon failure of the pump, the BAS shall enunciate an alarm and asses the pump as failed. The boiler controller shall then swap the lead primary system (as described above.) Alarm Management Proof/Failure Assessment: BAS shall assess the boiler as failed, any time the boiler alarm contacts are ON. Upon failure of the Boiler, the BAS shall enunciate an alarm at the BAS.
3. **Secondary Hot Water Supply Temperature Setpoint**: The BAS shall reset the secondary hot water supply temperature setpoint. The HW Supply Temperature setpoint shall be reset from 130°F to 160°F as the outside air temperature drops from 60°F to 40°F (all values being adjustable)
4. **Lead/Lag**: The onboard boiler controls shall stage the boilers ON/OFF and modulate the firing rate as necessary to maintain the secondary hot water supply temperature at setpoint.

## 3.10 EXHAUST FAN OPERATION

A. Toilet Exhaust Fans

1. The BAS shall schedule the on/off operation of toilet exhaust fans based on time-of-day schedule that is adjustable by owner.
2. Should a fan fail to start based on current sensor input an alarm shall be generated.
3. Should any AHU return to occupied operation via override the exhaust fan in that area shall be indexed on.

## 3.11 HEAT TRACE

A. Exterior Pipe
1. The BAS shall monitor the heat trace system to verify system is functioning.
2. The BAS shall alarm when heat trace system not functioning.

**END OF SECION 230993**

## SECTION 23 11 23 - NATURAL GAS AND PROPANE PIPING

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.

B. Valves.

C. Natural Gas Piping System.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

1.3 REFERENCES

A. ANSI/AWS D1.1 - Structural Welding Code.

B. ANSI AGA-LC1 - Standards for Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing.

C. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

D. ASME - Boiler and Pressure Vessel Code - Section 9.

E. ASME B1.20.1 - Pipe Threads, General Purpose.

F. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

G. ASME B16.5 - Pipe Flanges and Flanged Fittings.

H. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.

I. ASME B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.

J. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.

K. ASME B16.39 - Malleable Iron Threaded Pipe Unions.

L. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.

M. ASME B18.2.2 - Square and Hex Nuts, Inch Series.

N. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

O. ASTM A105 - Standard Specification for Carbon Steel Forgings for Piping Applications.

P. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.

Q. ASTM A197 - Standard Specification for Cupola Malleable Iron.

R. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

S. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

T. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

U. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.

V. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe.

W. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

X. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

Y. NFPA 54 - National Fuel Gas Code.

## 1.4 SUBMITTALS

A. Submit product data under provisions of Section 22 05 0023 05 00. Include data on pipe materials, fittings, valves, and accessories.

B. Test Reports: Provide results of piping system pressure test.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

## PART 2 - PRODUCTS

2.1 NATURAL GAS (0 TO 125 PSI)

A. Design Pressure: 125 psi.

1. Maximum Design Temperature: 350F

B. Piping - 2" and Under:

1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53.
2. Joints: Screwed. (NOTE: For below ground, all sizes to have welded joints.)
3. Fittings: 150# steam - 300# CWP, black malleable iron, banded, ASTM A197, ANSI B16.3.
4. Unions: 250# - 500# CWP, black malleable iron, ANSI B16.39, ground joint with brass seat.

C. Piping - 2-1/2" and Over:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53.
2. Joints: Butt welded or flanged.
3. Fittings: Standard weight seamless steel, butt weld type, ASTM A234, Grade I, ANSI B16.9.
4. Flanges: 150# forged steel, weld neck or slip-on, ASTM A181, Grade I, ANSI B16.5. Flange face seal weld (backweld) is required for slip-on flanges.

D. Shutoff Valves/Throttling Valves:

1. BA-13: 2" and under, threaded, full port, 600 psi CWP; UL listed for 250# LP, flammable liquid, heating oil, natural and manufactured gases, 150 psi steam, chrome plated brass ball, Teflon seats and packing.

a. Body: Bronze.

2. BA-14: 1/2" through 12", flanged, full port, 280 psi CWP; UL listed for class 150 LP, flammable liquid, heating oil, natural and manufactured gases, 150 psi steam, stainless steel ball and stem, Teflon/PTFE/TFM 1700 seats and packing, ASME B16.5 and B16.33, B16.34, or B16.38.

a. Body: Carbon Steel ASTM A216 WCB

3. PL-1: 2" and under, 125# steam 450F, 175# CWP 180F, cast iron body, screwed, full port.
4. PL-2: 2-1/2" thru 4", 125# steam 450F, 175# CWP 180F, flanged, cast iron body, full port.

E. Check Valves:

1. CK-1: 2" and under, 125# steam at 406F, 200# CWP at 150F, screwed, bronze, horizontal swing.
2. CK-13: 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size.

F. Strainers:

1. For pipe systems where mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
2. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S at 350F, 175 psi CWP at 150F.
3. ST-4: Cast iron body, screwed ends, screwed cover, 250# steam at 406F, 300# CWP at 150F.

2.2 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

1. Gases:

a. 1/4" - 2": 1/32" perforations
b. 2-1/2" - 10": 3/64" perforations
c. 12" - 18": 1/16" perforations

B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.

C. Use iron body strainers in ferrous piping.

2.3 DRAIN VALVES AND BLOWDOWN VALVES

A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

**PART 3 - EXECUTION**

3.1 PREPARATION

A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

D. Connect to all equipment with flanges or unions.

E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

## 3.2 TESTING PIPING

A. Low Pressure - Up to 1 psi:

1. Test piping with 20 psi air pressure. System must hold this pressure without adding air for two hours.

B. High Pressure - Above 1 psi:

1. Test piping with compressed air at twice the operating gas pressure, but at least 20 psi. System must hold this pressure without adding air for two hours.

C. A non-combustible odorant, such as oil of wintergreen, may be added to help locate leaks.

## 3.3 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

## 3.4 INSTALLATION

A. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.

B. Install piping to conserve building space, and not interfere with other work.

C. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.

G. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.

H. Provide clearance for access to valves and fittings.

I. Provide access doors where valves are not exposed.

J. Prepare pipe, fittings, supports, and accessories for finish painting.

K. Install valves with stems upright or horizontal, not inverted.

L. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.

M. Provide shutoff valves to isolate part of systems and vertical risers.

N. Provide shutoff valves to boilers and water heaters in readily accessible location, maximum 6 feet above finished floor, within 6 feet of boiler connection per ASME CSD-1.

O. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

P. Reducers are generally not shown. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.

Q. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

R. All vertical pipe drops to equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted..

## 3.5 BONDING AND GROUNDING

A. Each above ground portion of a gas piping system, other than corrugated stainless steel tubing systems, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than corrugated stainless steel tubing, shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

B. Gas piping shall not be used as a grounding conductor or electrode.

C. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780, Standard for the Installation of Lightning Protection Systems.

## 3.6 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.

B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.

D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.

E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be long radius type, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.

F. Use full and double lengths of pipe wherever possible.

G. Cut all pipe to exact measurement and install without springing or forcing.

H. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

## 3.7 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage.

B. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install gas pipes with bottom of pipe and eccentric reducers in a continuous line.

C. Provide drip legs at low points and at the base of all risers in gas pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

## 3.8 BRANCH CONNECTIONS

A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.

B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

C. Use of forged weld-on fittings is also limited as follows:

1. Must have at least same pressure rating as the main.
2. Header or main must be 2-1/2" or over.
3. Branch line is at least two pipe sizes under header or main size.

D. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

E. All branch piping connections for natural gas shall take off on the top or on the side of the main.

## 3.9 JOINING OF PIPE

A. Threaded Joints:

1. Ream pipe ends and remove all burrs and chips.
2. Protect plated pipe and valve bodies from wrench marks when making up joints.
3. Apply gas-rated Teflon tape or thread compound to male threads.

B. Flanged Joints:

1. Steel flanges shall be raised face.
2. Bolting for services up to 500F shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".
3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:

    a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
    b. Maximum pressure rating of at least 250 psig.
    c. Minimum temperature rating: -10F.
    d. Maximum temperature rating of at least 170F for water systems operating 140F and less.

C. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

D. Fusion Weld:

1. Make all field cuts of pipe square and true using a pipe cutter designed for plastic pipe.
2. Make sure proper heating heads are used for male and female situations.
3. Bevel the leading edge of pipe section with a 45-degree chamfer.
4. Utilize a fusion welding tool recommended and/or provided by the pipe and fitting manufacturer.
5. Not recommended for temperatures below 40F.
6. Follow the manufacturer's cold weather installation procedures.
7. All installers shall undergo training provided by the manufacturer or manufacturer's representative.
8. Follow all manufacturer's installation instructions.

## 3.10 PAINTING EXPOSED PIPE

A. Paint all outdoor exposed natural gas piping the color selected by Owner or Architect/Engineer.

## 3.11 SERVICE CONNECTIONS

A. Provide new gas service complete with gas meter and regulators. Verify gas service pressure with the Utility Company.

**END OF SECTION 231123**

**THIS PAGE INTENTIONALL LEFT BLANK**

## SECTION 23 21 00 - HYDRONIC PIPING

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings

B. Valves

C. Check Valves

D. Strainers

E. System Piping Schedule

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 REFERENCES

A. ANSI/AWS D1.1 - Structural Welding Code.

B. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.

C. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.

D. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

E. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile Iron Pipe.

F. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

G. ANSI/AWWA C153/A21.51 - Ductile Iron Compact Fittings, Centrifugally Cast for Water or Other Liquids.

H. ASME - Boiler and Pressure Vessel Code.

I. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

J. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

K. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

L. ASME B16.5 - Pipe Flanges and Flanged Fittings.

M. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.

N. ASME B16.12 - Cast Iron Threaded Drainage Fittings.

O. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings

P. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.

Q. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

R. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).

S. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

T. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings.

U. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.

V. ASME B18.2.2 - Square and Hex Nuts, Inch Series.

W. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.

X. ASME B31.9 - Building Services Piping.

Y. ASME Section 9 - Welding and Brazing Qualifications.

Z. ASTM A126 - Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.

AA. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

BB. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.

CC. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

DD. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

EE. ASTM A536 - Standard Specification for Ductile Iron Castings

FF. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.

GG. ASTM B32 - Standard Specification for Solder Metal.

HH. ASTM B88 - Seamless Copper Water Tube.

II. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.

JJ. ASTM D1599 - Standard Test Method for Short-Time Hydraulic Failure Pressure of Plastic Tubing and Fittings.

KK. ASTM D2105 - Standard Test Method for Longitudinal Tensile Properties of Fiberglass Pipe and tube.

LL. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate loading.

MM. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

NN. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

OO. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

PP. ASTM D2992 - Standard Practice for Obtaining Hydrostatic Design Basis for Fiberglass pipe and fittings.

QQ. ASTM D2996 - Standard Specification for Filament Wound Fiberglass Pipe.

RR. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

SS. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

TT. ASTM D4024 - Standard Reinforced Thermosetting Resin Flanges.

UU. ASTM D5685 - Standard for Fiberglass Pressure Pipe Fittings.

VV. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

WW. ASTM E413-87 - Classification for Rating Sound Insulation

XX. ASTM F2389 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.

YY. ASTM F3226 - Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems.

ZZ. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

**PART 2 - PRODUCTS**

2.1 STEEL PIPE (ABOVE GRADE)

A. Design Pressure 125 psig, Maximum Design Temperature 225F (230F for grooved couplings).

B. Black Steel; Standard Weight; Threaded Joints:

1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53; Type E, F, or S; Grade B.
2. Joints: Screwed.
3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4; or Class 150 malleable iron, ASTM A197, ASME B16.3.
4. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.

C. Black Steel; Standard Weight; Welded or Flanged Joints:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.
2. Joints: Butt-welded or flanged.
3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.
4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges. Flange face seal weld (backweld) is required for slip-on flanges.

D. Black Steel; Standard Weight; Welded:

1. Design Pressure: 125 psi. Maximum Design Temperature: 1000F.
2. Pipe: Standard weight black steel, beveled ends, ASTM A53.
3. Joints: Butt welded.
4. Fittings: Standard weight seamless steel, butt weld type, ASTM A234, Grade WPB, ANSI B16.9.

## 2.2 COPPER PIPE (ABOVE GRADE)

A. Design Pressure 125 psig. Maximum Design Temperature 225F.

B. Copper Pipe; Type L; Soldered Joints:

1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.
2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
3. Fittings: Wrought copper solder joint, ASME B16.22.

## 2.3 DUCTILE IRON PRESSURE PIPE (UNDERGROUND)

A. Design Pressure 200 psi, Maximum Design Temperature 150F.

B. Ductile Iron Pipe; Pressure Water Pipe; Mechanical Joints:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.
2. Fittings: Ductile iron, ANSI/AWWA C110/A21.1 or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.

## 2.4 POLYPROPYLENE PIPING

A. Polypropylene; SDR 7.3, 9, or 11 as shown in Systems, Piping, and Valve Schedule; Socket or Electrofusion:

1. Pipe: Multilayer extruded PP-RCT polypropylene with fiberglass layer; SDR 7.3. 9, or 11. ASTM F2389.
2. Joints: Polypropylene socket fused or electrofusion.
3. Fittings: Polypropylene PP-RCT; PP-RCT/Brass (for connection to brass or iron threaded valves). Pipe and fittings shall be a system provided by the same manufacturer.
4. Limitations:

    a. Shall not be used in a plenum unless listed as 25/50 per ASTM E84/UL723.

b. Unless noted otherwise, pipe sizes indicated on drawings are based on standard steel and copper pipe sizes. Nominal polypropylene pipe sizes shall be increased as required to obtain similar steel and copper inside diameter. Refer to Equivalent Diameter Schedule on drawings.
c. Maximum Fluid Operating Temperature (with corresponding minimum pressure ratings):

1) SDR 11: 120F (165 psig)
2) SDR 9: 150F (160 psig)
3) SDR 7.3: 185F (145 psig)

B. Manufacturers:

1. Niron FG Clima
2. Aquatherm MF
3. Uponor
4. ASAHITEC

## 2.5 PREINSULATED CONDUIT SYSTEM (UNDERGROUND OUTSIDE)

A. Design Pressure 125 psig, Maximum Design Temperature: 210F.

B. Conduit System; Preinsulated; PVC Jacket:

1. Black Steel; Standard Weight; Welded Joints.

a. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.
b. Joints: Butt-welded.
c. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9. Pipe and fittings shall be a system provided by the same manufacturer.

2. Pipe Insulation:

a. Polyurethane foam with "K" factor not over 0.16 at 75F.
b. Density at least 2.25 lbs. per cubic foot.
c. Capable of continuous operation at 210F.

3. Outer Jacket:

a. Class 1, Grade 1, white seamless pressure rated PVC pipe, ASTM D1784.
b. Jacket thickness at least 80 mils .

4. Accessories:

a. Fitting insulation and covers shall match the pipe insulation.
b. Install gland seal terminations at all building and manhole entrances. Gland seals shall allow the inside pipe to move freely to allow for pipe expansion.

c. Provide 3/8" minimum thickness, integral pipe anchor plates where required. Secure plates to inner carrier pipe. Plate shall extend beyond outer jacket for anchoring in concrete. Seal plate completely to prevent entrance of any moisture.
d. Provide foam insulation sleeves, fitting covers and all other items needed to field insulate pipe joints.
e. Seal all field joints watertight with heat shrink bands. Bands shall extend at least 6" beyond each end of the joint sleeve.

## 2.6 VALVES

A. Shutoff Valves:

1. Gate Valves(Steel Pipe):

a. GA-1: 2" and under, 125 psi S at 353F, 300 psi WOG at 150F, screwed, bronze, rising stem, screwed bonnet.
b. GA-2: 2-1/2" thru 12", 125 psi S at 353F, 200 psi WOG at 150F, flanged, iron body, bronze mounted, OS&Y.

2. Gate Valves (Copper Pipe):

a. GA-5: 2" and under, 125 psi S at 353F, 200 psi WOG at 150F, solder bronze.

3. Ball Valves:

a. BA-1 (Steel and Copper): 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals.

1) Body: Bronze of a copper alloy containing less than 15% zinc.
2) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping. (For example, Jomar modifies valve part number with -IH for insulated handle.)
3) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120F, heating water piping over 120F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim. (For example, Jomar modifies valve part number with -LH for locking handle.)

b. BA-1A (Steel): 2-1/2" and 3", 125 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals.

1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.
2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120F, heating water piping over 120F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

4. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20F to 225F continuous and 250F intermittent at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze, stainless steel, or electroless-nickel coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), [infinite position locking operator with memory stop][10 position locking operator] up to 6" size. Cv of at least 1580 in 6" size.

## 2.7 THROTTLING VALVES

A. Throttling Valves (Steel):

1. Globe Valves (Steel Pipe):

a. GL-1: 3" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze.
b. GL-2: 4" thru 10", 125 psi S at 353F, 200 psi WOG at 150F, flanged, iron body, bronze mounted.

2. Globe Valves (Copper Pipe):

a. GL-5: 2" and under, 125 psi saturated steam, 300 psi WOG, solder, bronze.

3. Ball Valves (Steel and/or Copper):

a. BA-9: 2" and under, 125 psi saturated steam, 600 psi WOG, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless steel ball, Teflon seats and seals with memory stop.

4. Butterfly Valves:

a. BF-4:

1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20F to 225F continuous and 250F intermittent at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze, stainless steel, or electroless-nickel coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), infinite position locking operator with memory stop up to 6" size. Cv of at least 1580 in 6" size.

## 2.8 LOCK OUT TRIM

A. Provide lock out trim for all quarter turn valves opening to atmosphere installed in heating water piping over 120F and as indicated on the drawings.

## 2.9 CHECK VALVES

A. CK-1: Check Valves (Steel Pipe); 2" and under, 125 psi S at 353F, 200 psi WOG at 150F, screwed, bronze, horizontal swing.

B. CK-4: Check Valves (Copper Pipe); 2" and under, 200 psi WOG at 150F, solder, bronze, horizontal swing.

C. CK-13: Check Valves (Steel Pipe); 2-1/2" thru 12", 200# WOG, double disc wafer type, non-slam silent check, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size.

D. CK-14: Center Guided/Axial Sliding Disk Silent Check Valve: 2" thru 24", ductile iron body with stainless steel spring, suitable for vertical installation. Stainless steel disc(s) with elastomer seat/seal, or elastomer coated ductile iron disc with welded-in nickel seat.

## 2.10 STRAINERS

A. ST-1: Bronze body, screwed ends, screwed cover, 125 psi S at 353F, 200 psi WOG at 150F.

B. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S at 353F, 175 psi WOG at 150F.

C. ST-3: Grooved End Strainers: Ductile iron body, 300 psi CWP, grooved ends with coupled cover for strainer maintenance, with stainless steel basket.[ Design Basis: Victaulic Style 732 and AGS W732. and Titan Flow Control YS58UG-DI]

D. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

1. Pipe Size:

a. 1/4" - 2": 1/32" screen
b. 2-1/2" - 8": 1/16" screen
c. 10" and Up: 1/8" screen

E. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.

F. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.11 MANUFACTURED PUMP CONNECTIONS

A. Manufactured Vibration Isolation Pump Drops for Sizes 3" through 12": Installation ready with grooved joints, orange enamel coating, with flexible couplings to accommodate vibration attenuation and stress relief, and pipe spool with thermometer and pressure ports. Assembly rated for working pressure to 300 psig.

1. Discharge Pump Drop: Class 150 flange for pump connection, base elbow for horizontal pump connectionstraight line with concentric reducer for vertical pump connections, Venturi check valve and butterfly valve . Victaulic Series 380.
2. Suction Pump Drop: Suction diffuser with stainless steel basket and diffuser and Class 150 flange for pump connection, butterfly valve. Victaulic Series 381.

a. Additional wye-type strainer must be added upstream of suction diffuser to ensure proper straining.

3. Suction Pump Drop: Class 150 flange for pump connection, wye pattern strainer with stainless steel perforated metal basket, butterfly valve. Victaulic Series 382.
4. Discharge CBV Pump Drop: Class 150 flange for pump connection, base elbow for horizontal pump connectionstraight line with concentric reducer for vertical pump connections, Venturi check valve and Series 789 circuit balancing valve. Victaulic Series 383.

a. For use on pumps without variable frequency drives.

**PART 3 - EXECUTION**

A. PREPARATION

B. Ream pipe and tube ends, remove burrs, bevel plain-end ferrous pipe.

C. Remove scale and dirt on inside and outside before assembly.

D. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

E. Connect to all equipment with flanges or unions. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

F. Flush and clean piping as defined below. When system water is clear, remove, clean and replace all strainer screens (blowing down strainer without removing and cleaning screen is not acceptable).

G. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

H. Provide dielectric connections between dissimilar metals.

## 3.2 SYSTEMS, PIPING, AND VALVE SCHEDULE

A. Heating Water (Above Grade - maximum 200F unless noted otherwise below):

1. Black Steel; Standard Weight; Threaded Joints: 2" and Under
2. Copper Pipe; Type L; Soldered Joints: 2" and Under
3. Black Steel; Standard Weight: Welded or Flanged Joints: 2-1/2" and Over
4. Shutoff Valves: GA-1, GA-2, GA-5, BA-1, BA-1A (STEEL), BF-1, BF-5
5. Throttling Valves: GL-1, GL-2, GL-5, BA-9, BF-4, BF-5
6. Check Valves: CK-1, CK-4, CK-13, CK-14
7. Strainers: ST-1, ST-2, ST-3

B. Chilled Water (Above Grade):

1. Black Steel; Standard Weight; Threaded Joints: 2" and Under
2. Copper Pipe; Type L; Soldered Joints: 2" and Under
3. Black Steel; Standard Weight: Welded or Flanged Joints: 2-1/2" and Over
4. Shutoff Valves: GA-1 GA-2 GA-5), BA-1, BA-1A (STEEL), BF-1, BF-5
5. Throttling Valves: [GL-1][, GL-2][, GL-5][, BA-9][, BF-4][, BF-5]
6. Check Valves: CK-1, CK-4, CK-13, CK-14
7. Strainers: ST-1, ST-2, ST-3

C. Chilled Water (Underground):

1. Ductile Iron Pipe; Pressure Water Pipe; Mechanical Joints: All Sizes

D. Equipment Drains and Overflows:

1. Copper; DWV; Soldered: 4" (200 mm) and Under

## 3.3 TESTING PIPING

A. Test pipes underground or in chases and walls before piping is concealed.

B. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.

C. Test the pipe with water at 1.5 times the design pressure but not less than 125 psig pressure. Hold pressure for at least two hours.

D. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.

## 3.4 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

B. Chemical Cleaning:

1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.
2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical if discharge of trisodium phosphate is not permitted. Maintain 150F in the system if possible. If heat is not available, use 3 pounds per 100 gallons.
3. Drain the system after circulating the chemical cleaner for six hours at 150F, or 12 hours at a lower temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain and until water appears clear.

4. After each system has been cleaned and thoroughly flushed of pretreatment chemicals, it shall be immediately refilled with water and treated with chemical treatment as specified in Section 23 25 00. The system shall not be allowed to sit empty for any length of time.
5. When system water is clear, remove, clean and replace all strainer screens (blowing down strainer without removing and cleaning screen is not acceptable).
6. Water samples may be taken by the Architect/Engineer to verify a clean system. If system is not clean, the entire process, including chemical treatment specified in Section 23 25 00, shall be repeated at the Contractor's expense.
7. Chemical cleaning applies to the following systems:

    a. Heating Water
    b. Chilled Water

## 3.5 INSTALLATION

A. General Installation Requirements:

1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
2. Install piping to conserve building space, and not interfere with other work.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
6. Install bell and spigot pipe with bells upstream.
7. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.

C. Valves/Fittings and Accessories:

1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.
2. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
3. Provide clearance for installation of insulation, and access to valves and fittings.

4. Prepare pipe, fittings, supports, and accessories for finish painting.
5. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
6. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
7. Provide flanges or unions at all final connections to equipment, traps and valves.
8. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
9. Horizontal swing check valves may only be installed in horizontal position. Do not install horizontal swing check valves in upward or downward flow direction. Where upward or downward flow installation is required, use spring-assisted, non-slam check valve.

D. Underground Piping:

1. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.
2. Install thrust blocking and restraints on all underground piping at elbows and other changes in pipe direction.

## 3.6 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.

B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.

D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.

E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. 2-1/2" and larger fittings shall be long radius type, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.

F. Use full and double lengths of pipe wherever possible.

G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.

H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.

I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

## 3.7 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.

B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.

C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.

D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.

E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.

F. All vent and drain piping shall be of same materials and construction as the service involved.

## 3.8 BRANCH CONNECTIONS

A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.

B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

C. Use of forged weld-on fittings is also limited as follows:

1. Must have at least same pressure rating as the main.
2. Header or main must be 2-1/2" or over.
3. Branch line is at least two pipe sizes under header or main size.

3.9 JOINING OF PIPE

A. Threaded Joints (Steel Pipe):

1. Ream pipe ends and remove all burrs and chips.
2. Protect plated pipe and valve bodies from wrench marks when making up joints.
3. Apply Teflon tape to male threads.

B. Flanged Joints (Steel Pipe):

1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.
3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:

    a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
    b. Maximum pressure rating of at least 250 psig.
    c. Minimum temperature rating: -10F.
    d. Maximum temperature rating of at least 170F for water and glycol solution systems operating 140F and less.
    e. Maximum temperature rating of at least 250F for water and glycol solution systems operating above 140F and up to 180F.

C. Solder Joints (Copper Pipe):

1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
2. Flux shall be non-acid type conforming to ASTM B813.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470F melting point solder. Remove composition discs and all seals during soldering if not suitable for 470F.

D. Welded Joints (Steel Pipe):

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.

2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
5. Single-welded butt joints may be employed with or without the use of backing rings in all sizes. Where backing rings are not used on pumped pressurized systems, the root side of the weld shall either be chipped or ground flush with the piping wall. For services such as vents, overflows, and gravity drains, the backing ring may be eliminated, and the root of the weld need not be chipped or ground. Backing rings shall be of the material being welded.

E. Mechanical Joints (Ductile Iron):

1. Joints shall conform to ANSI/AWWA C104/A21.11. Gasket material shall be neoprene. The standard bolts and nuts of the pipe manufacturer shall be used and be coated at the factory with rust preventive lubricant after threading and tapping.
2. Final tightening of bolts shall be with a torque wrench for equal tension in all bolts.
3. All fittings shall be provided by one manufacturer. Mixing fittings will not be acceptable.

**END OF SECTION 232100**

**THIS PAGE INTENTIONALLY LEFT BLANK**

SECTION **23 21 16 - HYDRONIC SPECIALTIES**

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual Air Vents

B. Automatic Air Vents

C. Basket Strainers

D. Makeup Water Accessories

E. Safety Relief Valves

F. Triple Duty Valves

G. Suction Diffusers

H. Self-Contained Control Valves

I. Balancing Valves

J. Automatic Flow Control Valves

K. Venturi Flow Measurement

L. Combination Piping Packages

M. Expansion Tank

N. Sidestream Filters

O. Air Separators

P. Drain Valves and Blowdown Valves

Q. Acoustical Lagging

R. Glycol

S. Glycol Feed System

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 REFERENCES

A. ASME - Boiler and Pressure Vessel Code.

B. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.

C. ASME B31.9 - Building Services Piping.

D. ASME Section 9 - Welding and Brazing Qualifications.

E. ASTM A536 - Standard Specification for Ductile Iron Castings

F. ASTM B32 - Standard Specification for Solder Metal.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

**PART 2 - PRODUCTS**

2.1 MANUAL AIR VENTS

A. At end of main and other points where large volume of air may be trapped, use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

B. On branch lines and small heating units, use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

## 2.2 BASKET STRAINERS

A. Cast iron body, 125 lb. flanged ends, quick release bolted cover, rated for 125 psi at 350F, 175 psi WOG at 150F. Strainer to have 1/8" perforated basket or equivalent. Pressure drop not to exceed 5 ft. head maximum.

B. Basket strainer shall be supported from floor. Hanging strainer from pipes will NOT be acceptable.

C. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.

D. Furnish hinged cover for strainers below 6" in size. Furnish lifting lug to remove cover of strainers 8" and larger. Provide O-ring gaskets on all covers.

E. Furnish ASTM stamped 126-B or A216 grade WCB.

## 2.3 MAKEUP WATER ACCESSORIES

A. Pressure Reducing Valve:

1. For water fill lines to hydronic systems.
2. Removable strainer, field adjustable discharge pressure, brass body, disc and seat, union with 1/2" or 3/4" NPT sweat connection, 125 psig maximum working pressure, 225F maximum temperature.

B. Relief Valve:

1. For water fill lines to hydronic systems.
2. Cast iron or bronze body, 1/2" or 3/4" screwed connections, 125 psig working pressure, 225F maximum temperature. Minimum 500,000 Btuh capacity at 30 psig. Manual test lever.

C. Backflow Preventer:

1. Reduced pressure type as scheduled on the drawings.
2. Provide an air gap fitting and piping to drain.
3. If not indicated on the drawings, unit shall be same size as pipe.
4. Field test and tag units per manufacturer's instructions by a certified tester before initial operation.

## 2.4 SAFETY RELIEF VALVES

A. SRV-1 (Hydronic Heating Systems): Spring-loaded disc type with cast iron or bronze body, bronze or stainless steel disc, side outlet and lifting lever for maximum service of 125 psig at 250F. For relieving water during pressure fluctuations and in case of control failure. Capacities shall be ASME Section IV certified and labeled.

## 2.5 TRIPLE DUTY VALVE

A. Type TD-1: 2" and above, 175 psi working pressure, flanged, cast iron, non-slam check valve, calibrated throttling, shutoff capabilities, angle or straight pattern. Pressure drop with design flow at 100% open shall not exceed 10 feet. Size to match pipe (not pump outlet) size, but reduce size by not more than one (1) if needed to provide at least 3 feet of differential pressure across the flow measuring taps at scheduled flow rate.

B. Manufacturers:

1. Armstrong
2. Bell & Gossett
3. Taco
4. Wheatley
5. Victaulic

**C.** Triple duty valves may replace the combination of shutoff valve, balancing valve, and check valve on constant volume systems. Triple duty valves are not permitted on variable volume systems.SUCTION DIFFUSER

A. Furnish and install on base-mounted pumps with inlet size same as pipe size shown on the drawing.

B. In no case shall pressure drop exceed 3.0 psi.

C. Suction diffuser shall consist of angle body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16" maximum diameter openings for pump protection, gauge tappings, and blowdown connection. Orifice cylinder, with bronze or stainless steel strainer with free area at least 5 times cross section area of pump suction opening. Furnish adjustable foot to support weight of suction piping. Connect drain valve to blowdown connection. Provide minimum 16 mesh bronze or stainless steel startup strainer. The startup strainer shall be removed after the system has been started, cleaned (refer to Hydronic Piping for additional information), and is operating under normal conditions, but before the system is turned over to the Owner. Hang the startup strainer on the piping near the pump after it is removed.

## 2.7 SELF-CONTAINED CONTROL VALVES

A. Thermostatic hot water control valves, self-contained bellows, nickel-plated body with EPDM disc, stainless steel spindle, and lifetime lubricated packing gland. Gland shall be replaceable with valve in operation.

B. Size for maximum pressure drop of 1 psi.

## 2.8 BALANCING VALVE

A. Rated for 125 psi working pressure and 250F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units that sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Valves in copper piping shall be brass or bronze.

1. Quarter-Turn Ball Valve Style (Brass or Bronze):

a. Manufacturers:

1) Bell & Gossett "Circuit Setter Plus"

D. Valves in ferrous piping 2" or smaller shall have threaded ends and steel, brass or bronze construction. Option to balancing valves noted above are flow sensors specified in Section 23 09 00 with a specified throttling valve.

1. Quarter-Turn Ball Valve Style (Ferrous Piping less than or equal to 2"):

a. Manufacturers:

1) Bell & Gossett "Circuit Setter Plus"

E. Balancing valves in ferrous piping over 2 size shall have flanged or grooved ends and steel or cast iron construction. Option to balancing valves noted above are flow sensor specified in Section 23 09 00 with a specified throttling valve.

1. Quarter-Turn Ball Valve Style (Ferrous Piping greater than 2"):

a. Manufacturers:

1) B&G "Circuit Setter"

F. Balancing valves in ferrous piping over 2" size shall consist of flow sensors as specified in Section 23 09 00 combined with specified throttling valves.

G. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

## 2.9 AUTOMATIC FLOW CONTROL VALVES (AUTOMATIC BALANCING VALVES)

A. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within ± 10% of the specified GPM over at least 95 percent of the control range.

B. Pump Head Requirements: The permanent pressure loss added to the pump head shall not exceed 7 feet <**insert**>.

C. Each valve shall have two P/T ports.

D. Five-year product warranty and first year cartridge exchange, up to 10 percent.

E. The internal wear surfaces of the valve cartridge shall be stainless steel or polyphenylsulfone orifice with an elastomeric diaphragm.

F. The internal flow cartridge shall be permanently marked with the GPM and spring range.

G. Valve body shall be brass on all valves 2" and under and ductile iron on all valves 2-1/2" and larger.

H. All valves shall be factory leak tested at 100 psi air under water.

I. A differential pressure test kit shall be supplied to verify flow and measure over-heading. The kit shall consist of a 4-1/2" diaphragm gauge equipped with 10 foot hoses and P/T adapters all housed in a vinyl case. Calibration shall be 0-35 PSID for 2-32 PSI spring range or 0-65 PSID for 5-60 PSI range.

J. Complete integral piping package, which integrates shutoff valves, automatic flow control valves, vents, strainers and drains, is acceptable.

## 2.10 VENTURI FLOW MEASUREMENT

A. Static Low loss Venturi: Flanged or grooved end, 400 psig at 250F working pressure; ANSI 150 pressure class; carbon steel body and insert; P/T ports for external gauge connection; ± 3% accuracy. Size venturi to match pipe (not pump outlet) size, but reduce size by not more than one (1) if needed to provide a minimum of 20" w.c. differential pressure across the flow measuring taps at scheduled design flow rate. In no instance shall pressure drop exceed 60" w.c. at scheduled design flow rate.

## 2.11 COMBINATION PIPING PACKAGES

A. Combination piping packages are allowed at all unitary and AHU coils in lieu of individual components specified for hydronic coils and devices containing hydronic coils. Configuration of combination pieces shall match layouts on the drawings. Each component of the combination piping packages shall meet these specifications for the individual components being combined. Coil connections shall be rigid or made with flexible hose equal to Metraflex SFLXTU18. Combination piping packages shall include:

1. Shutoff valves
2. Wye strainers, with minimum 1/4" turn strainer blowdown valves with hose thread and cap
3. Manual balancing valves with memory stop. Automatic flow control devices are allowed.
4. Test plugs
5. Manual air vents
6. Unions

## 2.12 EXPANSION TANK

A. Bladder Type:

1. Tank shall be welded steel, ASME construction and stamped.
2. Tank shall be complete with heavy-duty replaceable butyl bladder, charging valve, lifting ring, drain tapping, and system connection.
3. 125 psig working pressure and 240F maximum operating temperature.
4. Manufacturers:

    a. Thrush
    b. Taco
    c. Bell & Gossett
    d. Armstrong
    e. Watts
    f. Wessels
    g. Wheatley
    h. Amtrol
    i. Patterson
    j. Grundfos

## 2.13 BYPASS/SIDESTREAM FILTER

A. Cartridge filtration system rated for up to 50 gpm.

B. Filter vessel shall be 304 stainless steel and suitable for use up to 150 psi maximum operating pressure.

C. Vessel shall be equipped with an automatic air vent, manual air vent, and pressure gauge.

D. Filter shall be capable of removing 90% of all particles 5 microns and larger with each pass through the media.

E. Filter cartridge shall have a PVC core to prevent cartridge from collapse.

F. Filtration system shall be suitable for use up to 200F.

G. System shall be provided with close coupled centrifugal pump with strainer capable of providing flow as scheduled on drawings.

H. System shall be provided with control panel with disconnect, transformer to provide 120V 24V control power, overload and short circuit protection, dry contacts for connection to the building automation system, and single-point electrical supply connection.

I. Filtration system components shall be pre-piped and skid mounted as a single unit.

J. Mechanical Contractor shall provide and install shutoff valves on both up and downstream sides of filtration system, a check valve on suction side of pump between shutoff valve and pump, and drain piping to nearest trench drain.

## 2.14 TANGENTIAL AIR SEPARATORS

A. Separators shall be ASME constructed and stamped for 125 psi working pressure and 350F operating temperature.

B. Provide openings for inlet, outlet, blowdown, and expansion tank.

C. Separators shall be line size or larger, with maximum pressure drop of 1 psi. Refer to drawing for separator sizing.

D. Separators shall not include strainers, unless noted on the drawings. When furnished, strainers shall be removable and the blowdown fittings shall have drain valves.

## 2.15 DRAIN VALVES AND BLOWDOWN VALVES

A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

## 2.16 CONNECTIONS BETWEEN DISSIMILAR METALS

A. General:

1. Provide dielectric isolation at all pipe-to-pipe-to-equipment connections where dissimilar metals are joined, unless specifically noted otherwise below.
2. Dielectric fittings shall:

    a. Prevent direct metal-to-metal contact between dissimilar metals.
    b. Interrupt the electrical path to prevent galvanic current flow.

c. Be rated for the full operating pressure, temperature, and system test conditions.
d. Be listed and labeled for the intended service.

B. Materials Requiring Isolation

1. Isolation is required between aluminum, iron, steel, galvanized steel, stainless steel, copper, brass, and bronze, except as follows:

a. Iron and steel connected to each other.
b. Brass, copper, and bronze connected to each other.
c. Brass or bronze valves and specialties installed within closed hydronic systems and connected to steel, iron, or stainless steel piping on both sides.

2. Brass or bronze valves and specialties shall not be used as the sole dielectric separation between different pipe materials.

C. Pipe-to-Equipment Connections

1. Provide dielectric isolation at connections to equipment constructed of a material different than the piping system.

D. Grooved Mechanical Transition Couplings ( 2" (50 mm) thru 6" (150 mm)):

1. Grooved mechanical coupling rated for 300 psi (2065 kPa) CWP and 180F (82C). Consisting of two ductile iron housings, Grade P flouroelastomer gasket, and bolts and hex nuts zinc electroplated, ASTM B-633.
2. Provides a single coupling connection for grooved end stainless steel pipe to grooved end copper tubing of the same nominal size.
3. UL classified in accordance with ANSI / NSF-61 for potable water service.
4. For use only on Types 304 or 316 Schedules 10S and 40S stainless steel pipe, and ASTM B88 Type K, L, and M and ASTM B306 Type DWV copper tubing. Victaulic Style 644.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Valves/Fittings and Accessories:

1. Where a manual balance valve is shown to be installed in series with a service (isolation) valve, separate balance and service (isolation) valves shall be installed.
2. Install balancing valves with the manufacturer's recommended straight upstream and downstream diameters of pipe.

| Product | Upstream Diameters | Downstream |
|---|---|---|
| | | Diameters |

| | | |
|---|---|---|
| Griswald "Quickset" | 0 | 0 |
| Fluid Design "Accusetter" | 0 up to 2" size | 0 |
| | 5 for larger sizes | |
| Presso "B+" | 5 | 2 |
| Taco "Accu-flo" | 10 | 5 |
| IMI TA (Tour & Andersson) 786-789 | 5 after fittings | 2 |
| | 10 after pumps | |
| Bell & Gossett "Circuit Setter Plus" | 3 | 1 |
| Bell & Gossett "Circuit Setter" | 3 up to 4" size | 1 up to 4" size |
| | 5 above 4" size | 2 above 4" size |
| Armstrong "CVB" and "CVB-II" | 10 | 5 |
| Gerand "BALVALVE Venturi" | 5 | 2 |
| NIBCO 1710/737 | 5 | 3 |

3. Prepare accessories for finish painting.
4. Install accessories with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
5. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
6. Provide flanges or unions at all final connections to equipment, traps and valves.
7. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

**END OF SECTION 232116**

## SECTION 23 21 23 - HVAC PUMPS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All pumps except where integral with a manufactured piece of equipment.

B. Pump controls where self-contained.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.

C. Submit motor data indicating compliance with Section 23 05 13.

## PART 2 - PRODUCTS

2.1 PUMPS - GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction shall permit complete servicing without breaking piping or motor connections.

C. Pumps shall operate at 1750 RPM unless specified otherwise.

D. Pump connections shall be flanged, whenever available.

E. Heating pumps shall be suitable for 225F water.

F. Motors shall comply with Section 23 05 13 including, but not limited to:

1. Single phase motors less than 1 HP shall be electronically commutated or shall have a minimum motor efficiency of 70%.
2. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service.
3. All 480 volt motors driven by VFDs shall be provided with shaft grounding rings or grounding brushes or ceramic bearings as a means to protect bearings from adverse shaft currents.

G. Pump impellers shall not have smaller diameters than those scheduled. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

H. Pumps specified in this section operating in clean water with a flow greater than 25 GPM and less than 459 feet head shall have a maximum Pump Energy Index (PEI) as scheduled on the drawings. In no case shall the PEI exceed 1.0.

## 2.2 BASE MOUNTED END SUCTION PUMPS

A. Type: Centrifugal, single stage.

B. Casing: Cast iron, single suction, rated for greater of 150 psi or 1.25 times actual working discharge pressure, flanged suction and discharge with gauge ports.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Shaft: High grade alloy steel with copper, bronze or stainless steel shaft sleeves.

E. Bearings: Grease lubricated roller or ball bearings with grease fittings. If pump will be insulated, grease fittings shall be extended 3" with rigid pipe to clear the insulation.

F. Drive: Flexible coupling with OSHA-approved guard.

G. Seals: Mechanical type with internal flushing rated for -20F to 225F with Buna elastomer, carbon primary ring, and ceramic stationary ring.

H. Baseplate: Heat treated cast iron or reinforced heavy steel.

I. Manufacturers:

1. Bell & Gossett
2. Taco
3. Armstrong

## 2.3 IN-LINE PUMP

A. Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for horizontal or vertical operation.

B. Casing: Cast iron, rated for greater of 125 psi or 1.5 times actual working discharge pressure, flanged suction and discharge with gauge ports.

C. Impeller: Bronze or stainless steel, fully enclosed, dynamically balanced, keyed to shaft and secured with locknut.

D. Shaft: Steel or stainless steel.

E. Seals: Mechanical type with internal flushing rated for -20F to 225F and comprised of Buna elastomer, carbon primary ring, and ceramic stationary ring.

F. Seals: Mechanical type rated for -20F to 250F with EPR or EPT bellows and seat gasket, carbon primary ring, and silicon-carbide stationary ring.

G. Manufacturers:

1. Bell & Gossett
2. Taco
3. Armstrong

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturer's recommendations.
2. Support piping adjacent to pumps so that no weight is carried by pump casings. Provide supports under elbows on 4" and larger pump suction and discharge pipes. Allow a minimum of 18" clearance for removal of suction diffuser.
3. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
4. Install on vibration isolators as scheduled on drawings.
5. Where electronically commutated motors are equipped with manual speed adjustment, pump speed shall be adjusted during the testing, adjusting, and balancing phase to achieve scheduled performance.

B. In-Line Pumps:

1. Support in-line pumps individually so there is no strain on the piping. Install with a minimum of five diameters of straight pipe on pump suction and discharge.
2. Pump orientation shall be in accordance with the manufacturer's recommendations.

C. Base-Mounted Pumps:

1. Base-mounted pump shall be aligned in accordance with the pump manufacturer’s recommendations. A factory-trained representative shall laser align the pump to meet the manufacturer’s requirements and tolerances. An alignment report shall be provided as part of the project closeout documents.
2. Unless otherwise shown on the drawings, mount all base mounted pumps on 4" high concrete pads and anchor frames to pads with cast-in-place anchors.
3. All base-mounted pumps shall be grouted-in. Follow manufacturer's instructions for grouting.

**END OF SECTION 232123**

**THIS PAGE INTENTIONALLY LEFT BLANK**

## SECTION 23 23 00 - REFRIGERATION PIPING AND SPECIALTIES

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping and Pipe Fittings

B. Moisture and Liquid Indicators

C. Check Valves

D. Pressure Relief Valves

E. Filter-Driers

F. Suction Filters

G. Solenoid Valves

H. Expansion Valves

I. Receivers

J. Suction Accumulators

1.2 QUALITY ASSURANCE

A. Remanufactured specialties are not acceptable.

1.3 REFERENCES

A. ANSI/ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.

B. ANSI/ASME SEC 9 - Boilers and Pressure Vessels Code, Welding and Brazing Qualifications.

C. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. ANSI/ASME B31.5 - Refrigeration Piping.

E. ANSI/ASTM B32 - Solder Metal.

F. ANSI/ASTM B88 - Seamless Copper Water Tube.

G. ANSI/AWS A5.8 - Brazing Filler Metal.

H. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit layout of entire piping system including equipment, critical dimensions, and all pipe sizes, traps, valves, and accessories. Layout shall be a custom drawing for this job, not a standard detail. The refrigeration equipment supplier shall stamp the approval on layout drawings.

C. Submit product data for specialties, including manufacturers catalog information.

D. Submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labels in place.

B. Protect piping and specialties from entry of foreign material by leaving caps and plugs in place until installation.

**PART 2 - PRODUCTS**

2.1 PIPING

A. Design Pressure: 450 psig.

1. Maximum Design Temperature: 250F.

B. Piping - 4" and under; Brazed Joint:

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.
2. Joints: Brazed with silver solder.
3. Fittings: Wrought copper solder joint, ANSI B16.22.
4. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

## 2.2 MOISTURE AND LIQUID INDICATORS

A. UL listed, with copper, brass, or copper-plated steel body, flared or solder ends, extended fittings in units up to at least 1-1/8" to allow brazing without removing the cartridge, sight glass, color coded paper moisture indicator that is replaceable without breaking piping connections for units up to 1-1/8" size, and plastic cap; maximum working pressure of 500 psi, and maximum temperature of 200F.

## 2.3 VALVES

A. BA-14: Refrigerant Ball Valve: 3/8" thru 3-1/8", 500 psi, -40F to +300F, full-port up to 2-1/8" size, blow-out proof, PTFE seals, brass ball with equalizing orifice, visible position indication, seal cap, extended copper connections, replaceable stem seals, compatible with all CFC, HCFC, and HFC refrigerants.

## 2.4 SOLENOID VALVES

A. Valve: AHRI 760; pilot operated; copper or brass body and internal parts; synthetic seat; stainless steel stem and plunger assembly; extended solder ends to permit installation without disassembly; maximum working pressure of 500 psi; normally closed. Maximum pressure drop at system flow of 5 psi for R410a and 3 psi for R134a.

B. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, surge protector and color-coded lead wires, integral junction box, Class F temperature rated, ANSI/UL 429.

## 2.5 EXPANSION VALVES

A. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10F super heat. Select to avoid being undersized at full load or excessively oversized at part load.

## 2.6 RECEIVERS

A. All receivers shall have capacity to hold the entire refrigerant charge when 90% full at 90F per ASHRAE 15-78.

## 2.7 SUCTION ACCUMULATORS

A. All accumulators shall have capacity to hold 50% of the refrigerant charge when 90% full at 90F per ASHRAE 15-78, pressure drop equivalent to under 0.5F at peak capacity, a finish that survives a 500-hour salt spray test, vertical design with dip tube and screened oil inlet orifice, and a hot gas boil-out coil to evaporate liquid refrigerant.

2.8 EXPANSION COMPENSATION

A. Assembly consisting of two flexible connectors, two copper flexible connectors, two 90-degree elbows, and a 180-degree return pipe. Unit shall be in the form of a pipe loop.

B. Connectors shall have corrugated copper hose bodies with copper braided casings.

C. Connectors shall be rated for 150 psi working pressure at 70F.

D. Sizes 2" and smaller shall have copper sweat ends.

E. Connectors shall be suitable for 1/2" permanent misalignment.

## PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories.

3.2 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

F. Group piping whenever practical at common elevations and locations. Slope piping 1% in direction of oil return.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Provide access doors for concealed valves and specialties.

J. Where pipe support members are welded to structural building frame, brush clean, and apply zinc rich primer to welding.

K. Insulate piping and equipment; per Section 23 07 19 and Section 23 07 16.

L. Provide external equalizer piping on expansion valves, and locate expansion valve sensing bulb immediately downstream of evaporator on suction line. Connect distributor to expansion valve outlet.

M. Install flexible connectors parallel to the shafts of compressors.

N. Fully charge system with refrigerant after testing.

## 3.3 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job immediately.

B. All pipe, fittings, valves, equipment and accessories shall have factory applied identification sufficient to determine their conformance with specified requirements.

C. Exercise care at all times to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.

D. During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.

E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings.

F. Cut all pipe to exact measurement and install without springing or forcing.

## 3.4 APPLICATION

A. Provide solenoid valves in liquid lines of systems, in oil bleeder lines to stop flow of oil and refrigerant into the suction line when system shuts down, and in hot gas bypass lines, as applicable.

B. Provide refrigerant charging valve connections.

C. Provide replaceable cartridge filter-driers, with three-valve bypass assembly and suction filters without bypass assembly.

## 3.5 JOINING OF PIPE

A. Brazed Joints:

1. Make up joints with brazing filler metal conforming to ANSI/AWS A5.8. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt, and grease just prior to brazing. Apply flux evenly, but sparingly, to all surfaces to be joined. Brazing filler metal with a flux coating may also be used. Heat joints uniformly to proper brazing temperature so braze filler metal flows to all mated surfaces. Wipe excess braze filler metal, leaving a uniform fillet around cup of fitting.
2. Flux shall conform to ANSI/AWS A5.31.
3. Remove composition discs and all seals during brazing if not suitable for a minimum of 840F or greater than the melting temperature of the brazing filler metal, whichever is greater.

3.6 FIELD QUALITY CONTROL

A. Test piping system with nitrogen at 300 psig for at least 8 hours without loss of pressure.

B. Comply with ASHRAE Standard 147 for refrigerant system integrity testing.

C. After pressure testing, evacuate all refrigerant piping to at least 28" of mercury for 24 hours without loss of vacuum. Ensure moisture does not enter the piping prior to and during the tests.

**END OF SECTION 232300**

## SECTION 23 25 00 - CHEMICAL (WATER) TREATMENT

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Treatment for Closed Systems (Water).

B. Chemical Feed Equipment.

1.2 REFERENCES

A. ASTM D 859-00: Test Method for Silica in Water

B. ASTM D 1066-97: Practice for Sampling Steam

C. ASTM D 1067-92: Test Methods for Acidity or Alkalinity in Water

D. ASTM D 1068-03: Test Methods for Iron in Water

E. ASTM D 1126-02: Test Method for Hardness in Water

F. ASTM D 1129-03a: Terminology Relating to Water

G. ASTM D 3370-95a: Practices for Sampling Water from Closed Conduits

H. AWWA C700-02: Cold-Water Meters - Displacement Type

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Include system schematics, equipment locations, and controls schematics.

C. Submit product data indicating chemicals and equipment.

D. Submit manufacturer's installation instructions.

E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

F. Submit reports indicating start-up of treatment systems is completed and operating properly. Include reports indicating analysis of system water after cleaning and after treatment.

## 1.4 EXTRA STOCK

A. Provide clean cartridges or bags in all bypass (pot) feeders with filters and sidestream filters.

B. Provide two complete sets of replacement cartridges or filters for each bypass (pot) feeder with filters and sidestream filter installed. Deliver to Owner at job site.

## 1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include data on pumps and other equipment including spare parts lists, procedures, and treatment programs.

C. Include step-by-step instructions on test procedures including target concentrations and test frequencies.

D. Include list of treatment chemicals and associated SDS.

## 1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience. Company shall have local representatives with water analysis laboratories and full-time service personnel.

## 1.7 REGULATORY REQUIREMENTS

A. Conform to all applicable codes and regulations for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.

B. Provide only chemicals approved for use and disposal by local authorities. Contact the Architect/Engineer if any specified chemicals are prohibited.

## 1.8 MAINTENANCE SERVICE

A. Provide the following services to assist the owner in setting up and maintaining chemical treatment systems for one year from Date of Substantial Completion:

1. Provide technical service visits to perform field inspections and make water analysis on site. Visits shall be twice annually for closed systems and monthly for steam and cooling tower systems. For cooling tower systems, monthly testing shall have dipslide culture counts, and quarterly water samples shall be sent to a CDC Elite lab for culturing to establish baseline total organism and Legionella counts. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit copies of the field service report after each visit to the Owner and to the Mechanical Contractor. Any problems related to the operation of the chemical treatment program shall be reported to the Architect/Engineer.
2. Provide laboratory and technical assistance services for warranty period.
3. Include 8 hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start-up of systems.
4. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.
5. Provide sufficient chemicals for treatment and testing during warranty period.

B. The Chemical Treatment Subcontractor shall be responsible for assisting the Mechanical Contractor by adding the chemical solutions required for cleaning each piping system. During the remainder of the warranty period, the Chemical Treatment Subcontractor will be responsible for adding chemicals and doing other work related to the operation of system such as boiler blowdown. The Chemical Treatment Contractor shall make periodic tests of the chemical treatment program as called for above and recommend changes to Owner when needed.

1.9 WATER ANALYSIS

A. Sample feedwater to determine appropriate chemical treatment. Contact the Architect/Engineer if test indicates treatment required is different than that specified.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. Closed System Treatment (Water):

1. Provide one bypass feeder on each system. Install inlet, outlet and drain valves, and necessary piping.
2. Provide a 3/4" water meter in the domestic cold water line that provides makeup water to hydronic systems.
3. Provide coupon rack around main system pumps for all systems
4. Proprietary blend containing the following items:

a. Corrosion Inhibitors for Chilled Water Systems and Heating Systems operating at less than or equal to 145F: Sodium molybdate with added inhibitors such as mercaptobenzothiazole, sodium tolytriazole, or phenyltriazole to protect copper and brass and minimize dielectric pitting of steel. Maintain 50 ppm molybdate. Adjust borax content to keep correct pH for type of system (mainly steel or mainly copper).

b. Scale Inhibitor: Organic phosphonates such as aminomethylene-phosphonate; phosphonates such as hydroxyethylidenediphosphonate or polyamino-substituted phosphonates; or synthetic polymers such as low-molecular-weight polyacrylates, poly-methacrylates and polyacrylanides. Inorganic phosphates are not acceptable. Maintain residual concentration as recommended by the manufacturer.

## 2.2 EQUIPMENT

A. Bypass (Pot) Feeder: 2.0 gal; quick-opening cap with 3-1/2" minimum diameter opening and opening wrench, legs to raise fill cap to 30" to 36", drain valve, air cock, working pressure of 200 psig at 200F, 20 to 25-micron cartridge or bag filter.

B. Water Meter: Positive displacement type meter with bronze housing. 3/4" meter size. Meter to handle 1/2 - 30 GPM.

C. Coupon Test Rack:

1. Compliant with ASTM D 2688-05.
2. Materials:

a. Schedule 40 carbon steel; 1" (25 mm) diameter.

1) Design Temp/Pressure: 125 psig (865kPa) at 225F (107C)
2) Joints: Class 125, screwed

b. Schedule 80 CPVC; 1" (25 mm) diameter.

1) Design Temp/Pressure: 100 psig (690kPa) at 180F (82C)
2) Joints: Solvent cement, ATSM F493
3) Limitations: Only for system water temperature less than 180F

3. Pressure Rating: rated for the maximum expected system pressure and
4. Components: Rack shall include the following minimum components.

a. Inlet and outlet shut off valves,
b. Flow control valve to provide a constant velocity between 1.5 ft/s (0.5 m/s) and 6 ft/s (1.8 m/s) (5 GPM) (19 l/m),
c. One coupon holder for each metal in the piping system (four minimum),
d. 10 micron cartridge filter with sump and cap at 5 GPM (19 l/m) at 2.1 psig (14.5 kPa) pressure drop,
e. Sample drain port.

5. Installation: Support test rack independently from piping connected to sides of system piping with flow upward through test rack. Provide a coupon test rack for each closed loop hydronic system.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bypass (pot) feeder with top approximately 36" above the floor.

C. Coordinate with Contractor to provide temporary metering capabilities during system fill to determine overall system volume.

### 3.2 CLOSED-LOOP HYDRONIC SYSTEM WATER QUALITY STANDARDS

A. Review equipment manufacturer's water quality standard to ensure water quality is sufficient to meet their warranty requirements as well as to ensure peak heat transfer efficiency. Contractor shall maintain hydronic systems within the more stringent of either the equipment manufacturer's requirements or those listed below:

| Measured Value | Multi-Metal Systems with Aluminum | Multi-Metal Systems with Stainless Steel | Multi-Metal Systems with Copper |
|---|---|---|---|
| pH Range | 8.5 | 8.5 | 9.0 |
| Alkalinity as $CaCO_3$ | 100 - 500 mg/l | 100 - 500 mg/l | 100 - 500 mg/l |
| Hardness as $CaCO_3$* | 100 - 500 mg/l | 100 - 500 mg/l | 100 - 500 mg/l |
| Suspended Solids | less than 10 mg/l | less than 10 mg/l | less than 10 mg/l |
| Dissolved Solids | less than 1,000 mg/l | less than 1,000 mg/l | less than 1,000 mg/l |
| Chlorides | less than 150 mg/l | less than 150 mg/l | less than 150 mg/l |
| Iron | less than 5.0 mg/l | less than 5.0 mg/l | less than 5.0 mg/l |
| Manganese | less than 0.4 mg/l | less than 0.4 mg/l | less than 0.4 mg/l |
| Nitrate | less than 100 mg/l | less than 100 mg/l | less than 100 mg/l |
| Sulfate | less than 200 mg/l | less than 200 mg/l | less than 200 mg/l |
| Ammonia | less than 5.0 mg/l | less than 5.0 mg/l | less than 5.0 mg/l |

B. Submit an independent third-party test report for each chemically treated closed-loop system showing compliance with all measured values shown in the above table as part of project closeout documentation.

**END OF SECTION 23 25 00**

**THIS PAGE INTENTIONALLY LEFT BLANK**

## SECTION 23 31 00 - DUCTWORK

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized Ductwork

B. Ductwork Reinforcement

C. Ductwork Sealants

D. Rectangular Ductwork

E. Round and Flat Oval Ductwork

F. Exposed Ductwork (Rectangular, Round, or Oval)

G. Flexible Duct

H. Fire Resistive Ductwork and Accessories

I. Leakage Testing

J. Ductwork Penetrations

K. Duct Cleaning

L. Painting

1.2 REFERENCES: Conform to all applicable requirements of the following publications:

A. ADC Flexible Duct Performance and Installation Standards, 3rd Edition 1996.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/AWS A5.11M (1997) - Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding.

D. ASHRAE - Handbook Systems and Equipment; Chapter 19 - Duct Construction.

E. ASHRAE - Handbook Fundamentals; Chapter 21 - Duct Design.

F. ASTM A90 - Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

G. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.

H. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

I. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

J. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

K. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

L. ASTM E413-87 - Classification for Rating Sound Insulation.

M. AWS A5.14M (1997) - Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods.

N. AWS D9.1M/D9.1 - Sheet Metal Welding Code.

O. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.1.

P. IECC - International Energy Conservation Code (latest published edition)

Q. NADCA ACR - Assessment, Cleaning, and Restoration of HVAC Systems.

R. NADCA Standard 05 - Requirements for the Installation of Service Openings in HVAC Systems.

S. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

T. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.

U. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Equipment.

V. SCAQMD Rule 1168 - South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications.

W. SMACNA - Air Duct Leakage Test Manual.

X. SMACNA - HVAC Duct Construction Standards.

Y. SMACNA - Phenolic Duct Construction Standard 022.

Z. SMACNA - Round Industrial Duct Construction Standards - 1999 Edition.

AA. UL 181 - Factory-Made Air Ducts and Air Connectors.

BB. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors

CC. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.

## 1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00.

B. Submittals in this Section demonstrate compliance with duct fabrication standards and product requirements.

C. Submit duct fabrication standards in compliance with SMACNA and these specifications. Clearly indicate metal gauges, reinforcement, and joining methods intended for use for each pressure classification. Furnish details of all common duct fittings and joint connections to be used on this project.

D. The Architect/Engineer may require field verification of sheet metal gauges and reinforcing to verify compliance with these specifications. At the request of the Architect/Engineer, the contractor shall remove a sample of the duct for verification. The contractor shall repair as needed.

E. Coordination drawings are specified separately and are not included as part of these submittals.

F. Duct Layout Drawings (Coordination Input):
Prepare detailed duct layout drawings indicating proposed routing, fittings, elevations, dimensions including insulation thickness, hangers, access doors, and coordination with structural and architectural elements. These drawings are intended to serve as the ductwork basis for the coordination drawing process defined in Section 23 05 00. Duct layout drawings may be submitted for general conformance with design intent when requested, but will not be reviewed for full multi-trade coordination. Duct layout drawings are not coordination drawings and do not relieve the Contractor of responsibility to comply with Section 23 05 00.
   1. Duct layout drawings shall include, at a minimum, the following information: 1/4" minimum scale complete with the following information:
   2. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
   3. Differentiate ducts that are wrapped. Include insulation thickness, type of insulation, and acoustical lagging.
   4. Room names and numbers, ceiling types, and ceiling heights.
   5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.
   6. Verify clearances and interferences with other trades prior to preparing drawings. IMEG will provide electronic copies of ventilation drawings for contractor's use if the contractor signs and returns the "Electronic File Transfer" waiver. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for this submittal. Refer also to Section 23 05 00.

G. Duct Leakage Test Summary Report: Upon completion of the pressure test described in Part 3, the Contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.

1.4 DEFINITIONS

A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.

B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.

C. Interior Duct: Ductwork located within the conditioned envelope including return air plenums and indirectly conditioned spaces.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS AND SUPPORTS

A. Rectangular Duct - Single Wall:

1. General Requirements:

a. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.
b. Transitions shall not exceed the angles in Figure 4-7.

2. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

a. All ducts shall be cross-broken or beaded.
b. Snap lock seams are not permitted.
c. Turning vanes shall be used in all 90-degree mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:

1) Type 1:

a) Description: Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.
b) Usage: Limited to 3,000 fpm and vane lengths 36" and under.

2) Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.
3) Runners must be installed at a 45-degree angle. Elbows with different size inlet and outlet must be radius type.
4) Omitting every other vane is prohibited.

d. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. Mitered elbows (with or without turning vanes) may not be substituted for radius elbows. Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.

e. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45-degree entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.

f. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.

g. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45-degree rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.

h. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30-degree maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30-degree angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.

i. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.

j. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6" in length.

k. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

    1) Apply sealant to all inside corners. Holes at corners are not acceptable.

l. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

    1) Apply sealant to all inside corners. Holes at corners are not acceptable.
    2) Flanges shall be 24-gauge minimum (not 26 gauge).

B. Round and Flat Oval Spiral Seam Ductwork - Single Wall:

1. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.
2. 90-degree elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
3. Duct and fittings shall meet the required minimum gauges listed in Chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.
4. Ductwork shall be suitable for velocities up to 5,000 fpm.
5. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.
6. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
7. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.
8. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.
9. Transverse Joint Connections:

    a. Crimped joints are not permitted.
    b. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.
    c. Ducts and fittings larger than 36" shall have flanged connections.
    d. Secure all joints with at least 3 sheet metal screws before sealing.

C. Round Snap-Lock Seam Ductwork - Single Wall:

1. Factory sealed snap-lock pipe. Transverse and longitudinal seams shall contain factory-applied self-sealing EPDM and co-polymer gasket. Snap-lock shall conform to SMACNA RL-8. Duct and gasket material shall meet the flame/smoke spread rating of 25/50 per ASTM-E84.
2. G-60 galvanized coating meeting ASTM A653 and ASTM A90 G-90 galvanized steel aluminum meeting ASTM B209 Alloy 3003 Temper H14 304 stainless steel meeting ASTM A480 2B Finish.
3. Snap-lock seams are only permitted on systems between -1"w.c. and 2"w.c. pressure class.
4. 90-degree elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
5. Duct and fittings shall meet the required minimum gauges listed in Chapter 3 of the SMACNA requirements for the specified pressure class.
6. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.

7. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.

D. Hangers and Supports General Requirements:

1. Hanger and support materials shall be as defined within Materials and Application Specific section below.
2. Strap Hangers: Strap hanger shall be a minimum of 1 inch, 18 gauge attached to the bottom of ducts with spacing as required by SMACNA.
3. Cable Hangers:

    a. Aircraft cable and slip cable hangers are acceptable for ducts up to 18" diameter. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting rectangular ductwork.

4. Integral Corner Connector Hanger: Integral hanger and corner assembly for use with TDC/TDF style duct flanges. Die stamped offset hanger connects to the flanged corner assembly. For use with aircraft cable or 1/4" or 3/8" diameter threaded rods. Tested to hold up to 1,400 lbs.. Install per manufacturer’s ratings and instructions.

## 2.2 MATERIAL AND APPLICATION SPECIFIC

A. Galvanized Steel:

1. General Requirements:

    a. Duct and reinforcement materials shall conform to ASTM A653 and A924.
    b. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.
    c. Ductwork reinforcement shall be of galvanized steel.

2. Duct Hangers and Support Material:

    a. Ductwork hangers and supports shall be of galvanized or painted steel.
    b. All fasteners shall be galvanized or cadmium plated.

B. Duct Hangers and Support Material:

1. Ductwork hangers and supports shall be of galvanized or painted steel.
2. All fasteners shall be galvanized or cadmium plated.

C.

## 2.3 DUCTWORK REINFORCEMENT

A. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.

1. Ducts must be over 18" wide.
2. Duct dimensions must be increased 2" in one dimension (h or w) for each row of tie rods installed.
3. Tie rods must not exceed 1/2" diameter.
4. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

## 2.4 DUCTWORK SEALANTS

A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20F to +175F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M.

B. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20F to +250F.

## 2.5 FLEXIBLE DUCT

A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.

B. Flame Spread/Smoke Developed: Not over 25/50.

C. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.

D. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.

E. Standard:

1. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh. Usage: All areas unless noted otherwise.

2. Inner liner shall be airtight and suitable for 6" WC static pressure through 10" diameter and shall be airtight and suitable for 4" WC static pressure 12" through 16" diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A. "R" value shall not be less than 4.0 ft2*F*hr/Btuh. Temperature range of at least 0 to 180F. Maximum velocity of 4,000 fpm. "R" value shall not be less than 4.0 ft2*F*hr/Btuh.
3. Usage:

    a. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.
    b. Connections to air inlets and outlets. Do not exceed 6'-0" in length.

F. Radius Forming Elbows:

1. Flexible plastic radius forming elbow for use with flexible ducts to create 90deg elbow. One size for 6" to 16" diameter ducts. UL listed for return plenum spaces.
2. Usage: All supply air terminals with flexible ductwork connection.
3. Installation: Attach to flex duct and secure draw bands without crushing flex duct to form smooth radius elbow. Suspend radius forming elbow to structure. Install per manufacturer's instructions.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Provide openings in ducts for thermometers and controllers.

B. Locate ducts with space around equipment for normal operation and maintenance.

C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.

D. Provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork.

E. Supply ductwork shall be free of construction debris, and shall comply with Level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.

F. Repair all duct insulation and liner tears.

G. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.

H. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.

I. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.

J. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.

K. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.

L. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.

M. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.

N. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers unless coordinated with piping contractor prior to installation. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

## 3.2 DUCTWORK APPLICATION SCHEDULE

A. Refer to Ductwork Application Schedule below for specific requirements for system, material, shape, pressure class, seal class and insulation application.

B. Supply/Return/Exhaust/Outside Air Duct Outside Mechanical Room>

1. Shape: <Rectangular Duct - Single Wall / Round - Single Wall>
2. Material: <Galvanized Steel>
3. Pressure Class: <+6">
4. Seal Class: <A>
5. Insulation: <1-1/2" thick Type A (R=4.5)>
6. Additional Requirements: <None>

C. Supply/Return/Exhaust/Outside Air/Relief Inside Mechanical Room:

1. Shape: Rectangular Duct - Single Wall / Round - Single Wall
2. Material: Galvanized Steel
3. Pressure Class: +6"
4. Seal Class: A
5. Insulation: 2" thick Type B
6. Additional Requirements: Provide with Foil reinforced jacket and 8oz canvas jacket

## 3.3 SPECIAL INSULATION REQUIREMENTS

A. Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.):

1. Insulation:

a. ASHRAE 90.1-2022: 1-1/2" thick Type A (R=4.5)
b. IECC-2021: 1-1/2" thick Type A (R=4.5)

B. All Terminal Air Box/ Reheat Coil Headers and Duct Mounted Coil Headers:

1. Insulation: 1-1/2" thick Type A (R=4.5)

## 3.4 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.

B. All ducts systems, regardless of pressure class, shall be Seal Class A as defined by Section 5-1 of SMACNA HVAC Air Duct Leakage Test Manual per the Energy Code, unless specifically noted otherwise. Seal Class A shall include sealing of all transverse joints, longitudinal seams, and duct wall penetrations with welds, gaskets, mastics, or fabric-embedded mastic system. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

## 3.5 TESTING

A. Interior Duct - Less than 3" WG (positive or negative):

1. Leak testing of these pressure classes is not normally required for interior ductwork (inside the building envelope). However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

B. Interior Duct - 3" WG and Above (positive or negative):

1. Duct system shall be completely pressure tested or aerosol sealed and tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

C. Pressure Test Procedure:

1. Testing shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:

    a. The required leakage class for Seal Class A, rectangular ducts, shall be 4; round shall be 2.
    b. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.
    c. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.
    d. All joints shall be felt by hand, and all discernible leaks shall be sealed.
    e. 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.
    f. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.
    g. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.
    h. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.
    i. Positive pressure leakage testing is acceptable for negative pressure ductwork.

D. Aerosol Sealed and Tested Procedure:

1. Duct Preparation:
    a. Inspect air distribution systems for major leakage sites and significant accumulation of debris.
    b. Remove all debris and significant dust and dirt (greater than 1/8 inch deep) in air distribution system using NADCA approved duct cleaning method.

c. Ensure adequate structural support for new and existing ductwork, including structural integrity of all mechanical duct joints and transitions per SMACNA standards.
d. Temporarily remove or protect from aerosol particles building controls, fire and smoke sensors as recommended by manufacturer.
e. Temporarily disable fire alarms and notify appropriate authorities.
f. Temporarily isolate air-moving equipment and block off air inlets and outlets, and other devices and appurtenances as recommended by the manufacturer.
g. Protect occupied spaces from aerosol particles using manufacturer procedures.
h. All work shall be done in a substantial and workmanlike manner by factory trained technicians.

2. Duct Sealing:
   a. Repair all major leakage sites greater than 1/2 inch across using mastic and fiberglass mesh tape per SMACNA standards.
   b. Mastic and fiberglass mesh tape shall meet UL 181 standards.
   c. Seal existing ductwork from the inside using automated aerosolized sealant injection.
      1) Manufacturer: Aeroseal LLC, 225 Byers Rd., Miamisburg, OH 45342, 937-428-9300, www.aeroseal.com
      2) Application must be performed by a manufacturer approved service provider.
      3) Sealant shall comply with UL Outline Scope 1381.
      4) Sealant must cure with 2 hours with no VOC off-gassing thereafter.
      5) Sealant shall remain elastic after curing.
      6) Sealant shall be deposited substantially at areas of leakage only.
   d. Provide pre-sealing, post-sealing and sealing profile reports for all duct sections sealed.
   e. Repair all injection and test holes in existing ductwork using patching plates sealed tight per SMACNA standards.
   f. Any injection ports in duct board shall be made and repaired using pumpkin-cuts.
   g. Any insulation (internal or external) shall be replaced on the patching plate.
3. Duct Testing:
   a. Provide pre-sealing and post-sealing leakage profile reports indicating percentage reduction of leakage for supply, return and exhaust ductwork and shafts.
   b. Use manufacturer calibrated blower fan box with digital manometer to measure leakage before and after sealing.
   c. Following completion of air handling unit installations, duct repairs, and duct sealing, test all ductwork to ensure that the air distribution system is properly sealed.
      1) The supply ducts shall have air losses of less than 3% of the total air flow volume measured at the fan or air-moving device.
      2) The return ducts shall have air losses of less than 3% of the total air flow volume measured at the fan or air-moving device.
      3) The exhaust ducts shall have air losses of less than 5% of the total air flow volume measured at the fan or air-moving device.

4) Ducts shall be leak tested at a static pressure that is as close as possible to the system average operating static pressure. Duct test pressure should not exceed the lesser of the duct static pressure construction class, the duct system design static pressure or 2.5 in. w.g.

4. Duct Reassembly and Cleanup:
   a. Reinstall building controls and smoke detectors.
   b. Enable fire alarms and notify appropriate authorities.
   c. Remove blocking, reinstall grills and registers, and enable air handling fans.
   d. Cleanup sealant residue that may have adhered to surfaces in occupied areas as recommended by the Manufacturer.
   e. All work shall be done in a substantial and workmanlike manner by factory-trained technicians
5. Warranty:
   a. The Contractor shall warrant that the aerosol sealant application will be free of defects for a period of 3 years from date of the sealing application. If defects should occur during this period, the Contractor shall repair or replace the defective duct seals, including the direct labor costs for performing the repair or replacement, at no additional cost to the Owner.

## 3.6 DUCTWORK PENETRATIONS

A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.

B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.

C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install trim strip to cover vacant space and raw construction edges of all openings in finished rooms. Install escutcheon ring at all round duct openings in finished rooms. Trim strips and rings shall be same material and finish as exposed duct.

## 3.7 PAINTING

A. Paint interior of ducts black within twice the largest duct dimension of inlets and outlets where interior of duct is visible.

B. Paint bottom of ducts black within twice the largest duct dimension where a duct is routed above an unducted perforated grille and the duct is visible.

**END OF SECTION 233100**

## SECTION 23 33 00 - DUCTWORK ACCESSORIES

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual Volume Dampers.

B. Fire Dampers.

C. Backdraft Dampers.

D. Fabric Connectors.

E. Drip Pans.

F. Duct Access Doors.

G. Duct Access Sleeve.

H. Duct Test Holes.

I. Remote Volume Control Devices.

J. Temperature Control Dampers.

1.2 REFERENCES

A. AMCA Guide for Commissioning and Periodic Performance Testing of Fire, Smoke and Other Life Safety Related Dampers.

B. ASTM E477-20 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

C. ASTM E2336-04 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

D. NFPA 72 - National Fire Alarm and Signaling Code

E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

F. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

G. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.

H. SMACNA - HVAC Duct Construction Standards (latest edition).

I. UL 33 - Heat Responsive Links for Fire-Protection Service.

J. UL 555 - Fire Dampers and Ceiling Dampers.

K. UL 555C - Ceiling Dampers.

L. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

M. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit manufacturer's installation instructions.

**PART 2 - PRODUCTS**

2.1 MANUAL VOLUME DAMPERS

A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.

B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inches.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.

E. Provide locking quadrant regulators on single and multi-blade dampers.

F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

H. Contractor assembled modular manual dampers are acceptable as long as it contains the components listed above.

2.2 DYNAMIC CURTAIN BLADE FIRE DAMPERS (FD)

A. Furnish and install fire dampers in ducts, where shown on the drawings, at the point where they pass through a fire wall or a floor and in all other locations required by the local fire department, The National Fire Protection Association's Pamphlet No. 90A and all other applicable codes.

B. Fire dampers shall be UL 555 listed for 1-1/2-hour fire resistance unless noted otherwise, dynamic rated with heated airflow at 2000 fpm and 4" WC, and have all blades stacked out of the airstream (Type B).

C. Fire dampers shall be held open by a fusible link rated at 165F unless otherwise called for on the drawings or by local codes.

D. Dampers shall be installed in sleeves of sufficient thickness to comply with the UL555 Standard for Safety Fire Dampers listing of the damper. Where UL555 permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in NFPA 90A for breakaway style sleeves. If a breakaway style duct/sleeve connection is not used, 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 a factory installed access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the factory installed access door.

E. Maximum Curtain Damper Size (Multi-section) at less than 2000 fpm:

1. Vertical Installation: 72"w x 48"h or 48"w x 72"h or 120"w x 24"h.
2. Horizontal Installation: 36"w x 48"h or 48"w x 36"h.

F. Maximum Curtain Damper Size at greater than 2000 fpm: Vertical or horizontal - 24"w x 24"h.

G. Locate access door in the ductwork for visual inspection and on the latch side to replace link easily. Each access door shall have a label with letters at least 1/2" high, reading "FIRE DAMPER".

## 2.3 DYNAMIC MULTIPLE BLADE FIRE DAMPERS (FD)

A. General:

1. Furnish and install fire dampers in ducts, where shown on the drawings, at the point where they pass through a fire/smoke partition and in all other locations required by the local Fire Department, the National Fire Protection Association Pamphlet No. 90A, and all other applicable codes.
2. Fire Resistance Rating: Assemblies shall be 1-1/2 hour rated under UL Standard 555 unless noted otherwise on drawings.
3. Airflow Rating: Dynamic rated at 2000 fpm and 4" WC.
4. Temperature Rating: Assemblies shall be UL 555S listed for use in smoke control system with a 250F temperature rating.
5. Leakage Rating: Class II. Shall not leak over 20 CFM per square foot at 4" WC (Class II).

B. Construction:

1. Frame: 5 inches x minimum 16 gauge roll formed, galvanized steel hat-shaped channel, reinforced at corners.

2. Sleeve: Dampers shall be installed in sleeves of sufficient thickness to comply with UL555 Standard for Safety Fire Dampers listing of the damper. Where UL555 permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in NFPA 90A for breakaway style sleeves. If a breakaway style duct/sleeve connection is not used, 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.
    a. Wall Grille: When Damper is installed immediately behind wall grille, provide Style G sleeve with damper offset in sleeve with 3/4" full length grille mounting flanges. Grille provided separately. Refer to drawings for locations and quantities.
3. Blades: Opposed blade; airfoil-shaped, single piece, minimum 14 gauge double skin. Galvanized steel. Maximum 6" damper blades.
4. Seals: Blade seal shall be silicone fiberglass material to maintain smoke leakage rating to minimum of 450F and galvanized steel for flame seal to 1900F. Seal to be mechanically attached to blade edge. Jam seal shall be stainless steel, flexible metal compression type.
5. Bearings: Self-lubricating stainless-steel sleeve, in extruded hole in frame.
6. Axle: Minimum 1/2" plated steel, hex shaped, mechanically attached to blade.

C. Fusible Link: Fire dampers shall be held open by a fusible link rated at 165F unless otherwise called for on the drawings or by local codes.

D. Maximum Multi-Blade Size (Multiple Section) at 2000 fpm and 4" WC:

1. Vertical Installation: 120"w x 48"h or 64"w x 96"h.
2. Horizontal Installation: 120"w x 48"h or 60"w x 96"h.

E. Access Door: Locate access door in the ductwork for visual inspection and on the latch side to replace link easily. Each access door shall have a label with letters at least 1/2" high, reading "FIRE DAMPER".

## 2.4 BACKDRAFT DAMPERS

A. Gravity backdraft dampers, size 18 inches x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.

B. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90-degree stop, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

## 2.5 FABRIC CONNECTORS

A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer of fan or motor vibration.

B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.

C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and resistant to acids, alkalis, grease and gasoline, and shall be noncombustible.

D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that has a negative pressure, the length shall not exceed 2" in length.

E. All corners shall be folded, sealed with mastic and stapled on 1" centers.

F. Fabric connectors shall not be painted.

G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least one duct diameter from the fan to prevent inlet turbulence.

H. Materials:

1. Durodyne MFN-4-100
2. Vent Fabrics, Inc.
3. "Ventglas"
4. Proflex PFC3NGA

## 2.6 DUCT ACCESS DOORS

A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.

B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment requiring service inside the duct.

C. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

D. Access doors with sheet metal screw fasteners are not acceptable.

E. Minimum size for access doors shall be 24" x 16" or full duct size, whichever is less.

F. Fire Damper, Fire/Smoke Damper Access Provide quantity of access doors such that two hands can fit inside ductwork to manually reset fire dampers. For ducts larger than 12" x 12" , provide one access door. For ducts 12" x 12" and smaller, provide duct access sleeve.

## 2.7 DUCT ACCESS SLEEVE

A. Material: Galvanized G-90 ASTM A527 Access Section. 26 gauge galvanized 12" long constructed with Pittsburgh lock seam. Access section shall be suitable for ductwork pressure class and manufactured to maintain 100 percent of ductwork free area with a clamping type draw latch.

B. Leakage: Maximum of 1/2 CFM at 2" W.G..

C. Flange Connection: 18 gauge galvanized. Clamps: 20 gauge galvanized with zinc coated draw latch.

D. Gasket: Neoprene gasket 3/16" x 1-1/4", gasket profile forms to the inside of the clamp and seals the outer edges of the access section 18 gauge flanges. Seal seams in accordance with SMACNA HVAC Duct Construction Standard - Metal and Flexible.

E. Insulation: Contractor shall insulate in field per Duct Insulation Schedule. Include removable wrap around flanges.

F. Locations: Install duct access sleeve in the following locations:

1. Fire Dampers, Fire Smoke Dampers and Smoke Dampers: Provide duct access sleeve at dampers 12" x 12" and 12" diameter and smaller not more than 4" away from the fire damper sleeve.

## 2.8 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

## 2.9 REMOTE VOLUME CONTROL DEVICES - MANUAL

A. Remote volume control balancing damper shall be supplied with either miter gears or right angle worm gears. Provide all damper shafts, gearboxes, couplings, U-joints, bearings, shafts, offsets, adapters, and adjustable concealed covers as required.

B. When distances, angles, or offsets prevent installing solid rods, the mechanical cable control system may be utilized. Provide all damper shafts, rack and pinion gear operator, cables and sleeves, and adjustable ceiling mounting cups.

## 2.10 DUCTWORK ACCESSORY SEALANTS

A. Ductwork accessory sealants and adhesives shall conform to Section 23 31 00.

2.11 CONTROL DAMPERS AND DAMPER ACTUATORS

A. Control dampers and damper actuators shall be furnished by the Temperature Control Contractor (Section 23 0 900) and shall be installed by this Contractor.

B. Coordinate exact sizes, locations, and installation requirements with the Temperature Control Contractor.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install accessories in accordance with manufacturer's instructions.
2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.
3. Coordinate and install access doors provided by others.
4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24" x 24".
5. Provide duct test holes where indicated and as required for testing and balancing purposes.

B. Manual Volume Damper:

1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing. Use splitter dampers only where indicated.
2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote-controlled volume control device for operation of the damper. Coordinate location with the Architect/Engineer.

C. Drain Pan:

1. Drain pans shall be installed per ASHRAE 62.1.

    a. All drain pans shall be field tested under normal operating conditions to ensure proper drainage.
    b. Field testing of drain pans is not required if units with factory installed drain pans have been certified (attested in writing) by the manufacturer for proper operation when installed as recommended.

D. Control Dampers and Damper Actuators:

1. Install control dampers and damper actuators in accordance with manufacturer's instructions and in coordination with the Temperature Control Contractor.

2. Seal around damper frame inside ductwork with duct sealant to prevent bypass around damper.
3. Provide duct access door at each control damper.

**END OF SECTION 233300**

## SECTION 23 34 16 - CENTRIFUGAL FANS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. In-line Centrifugal Fans.

B. Cabinet Fans.

C. Performance Ratings: Bear the AMCA Certified Rating Seal - Air Performance.

D. Fabrication: Conform to AMCA 99.

E. Fan Energy Index (FEI): Fans shall meet or exceed the minimum FEI scheduled at the specified airflow, pressure, and air density (duty point). In no case shall the FEI at the specified duty point fall below 1.0.

1.2 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 208 - Calculation of the Fan Energy Index (FEI).

C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

E. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

F. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

G. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

H. SMACNA - HVAC Duct Construction Standards (latest edition).

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include data on all fans and accessories. Submit sound power levels for both fan inlet and outlet at rated capacity. Submit motor ratings and electrical characteristics, plus motor and electrical accessories. Submit multi-speed fan curves including minimum and maximum fan speed with specified operating points clearly plotted. Submit the Fan Energy Index (FEI) at the selected duty point.

B. Submit operation and maintenance data. Include instructions for lubrication, motor and drive replacement, and spare parts list.

1.4 EXTRA STOCK

A. Provide one extra belt set for each fan unit.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

## PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FAN

A. Fan Description: In-Line Single inlet, single width. backward inclined wheel.

B. Construction:

1. Wheel: Backward inclined, non-overloading, all aluminum wheel and hub. Dynamically balanced.
2. Housing: Galvanized steel construction with stainless steel or cadmium plated fasteners and galvanized steel belt guard.
3. Drive: Belt drive with motor mounted on top of housing. Cast iron, adjustable pitch sheaves. V-belt drive sized for 1.5 of maximum horsepower. Screw adjustment belt tightener.
4. Support: Steel or aluminum mounting frame with baked enamel finish. Steel mounting brackets suitable for any mounting position.

C. Protection:

1. Belt guards with tachometer knockouts on indoor fans. Removable weather covers on outdoor fans.

D. Motor (as scheduled on the drawings):

1. Induction: Furnish externally mounted open drip-proof, ball bearing motor, with adjustable mounts for belt tightening. Refer to motor specification for motor requirements.

    a. Disconnect as scheduled on drawings.

E. Bearings: Regreasable bearings rated for 40,000 hour B-10 life at specified operating point. Extend lubrication lines outside of housing.

F. Manufacturers:

1. Jenco Fan
2. Carnes
3. Cook
4. PennBarry
5. Greenheck

6. FloAire

2.2 CABINET FANS

A. Housing:

1. Heavy gauge steel reinforced and braced with steel angle framework.
2. Cleaned, phosphatized and painted with enamel or constructed entirely of galvanized steel.
3. Removable access panels for fan removal.
4. Insulate fan section interior with 1" thick, 3/4 lb. density fiberglass.
5. Insulated, corrosion-resistant drain pan under fan sections.
6. Minimum 12" x 18" hinged access doors on both sides of fan housing.

B. Fan:

1. Double width, double inlet, forward curved centrifugal, dynamically balanced.
2. Grease lubricated ball bearings, rated for 200,000 hours L-50 life at design operating conditions.
3. Extend lubrication lines for all bearings to an easily accessible location.
4. OSHA belt guards with openings for tachometer readings.

C. Motors and Drives:

1. Motor shall have slide rails, adjusting screws, anchor bolts and bedplates.
2. Adjust motor mounting bracket for tightening belts.
3. Open drip-proof motors with grease lubricated bearings, minimum 1/3 HP. Motors on variable frequency drives shall be VFD rated. Refer to Section 23 05 13.
4. V-belt drives with adjustable pitch sheaves for units 20 HP and below, fixed sheaves for larger units. Contractor shall provide replacement sheaves and belts for air balancing of the unit.
5. Furnish factory mounted and wired disconnect switch, non-fusible type with thermal overload protection.
6. Manufacturer:

    a. Greenheck
    b. Cook
    c. Aerovent
    d. FloAire

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. General Installation Requirements:

1. Prime all fan parts after cleaning, but prior to assembly. Apply a second finish coat to all exterior surfaces and all accessible interior surfaces after assembly. Apply rust preventative coating to shafts.
2. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
3. Install flexible connections between fan and ductwork. Install metal bands of connectors parallel with minimum 1" flex between ductwork and fan while running.
4. Provide safety screen where inlet or outlet is exposed. Screens shall meet OSHA regulations for size of openings.

**END OF SECTION 233416**

## SECTION 23 36 00 - AIR TERMINAL UNITS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Duct Variable Air Volume Terminal Box.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code.

B. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

C. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.

C. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate airflow, static pressure, and NC designation.

D. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch WG.

E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

F. Submit manufacturer's installation instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.

C. Include directions for resetting constant volume regulators.

## PART 2 - PRODUCTS

2.1 ACOUSTICAL CONSIDERATIONS (THIS APPLIES TO ALL UNITS)

A. All units shall have noise data certified in accordance with AHRI Standard 885-98 with 5/8" 20-lb. density mineral fiber ceiling tile and shall not produce space noise values over NC-35 due to radiated and airborne noise combined. Acoustical considerations shall take priority over sizes noted in schedule. It is the manufacturer's responsibility to increase inlet size to meet acoustic levels scheduled.

2.2 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX

A. 16 gauge aluminum housing with internal components of aluminum and stainless steel.

B. Nylon bushings at moving parts.

C. Venturi configuration for smooth variations in airflow.

D. Pressure independent operation without means of external monitoring devices. Box shall maintain constant volume at all flow rates regardless of changes in upstream or downstream static pressure.

E. Factory calibrate all boxes for the maximum and minimum cfm scheduled on the drawings. Settings shall be field adjustable by means of an external calibrated dial.

F. Boxes shall be gasketed for 100% shutoff capabilities, unless noted otherwise on the drawings.

G. Insulation:

1. Factory wrapped with minimum 3/8" elastomeric closed cell insulation. Insulation shall be UL listed and meet NFPA 90A requirements.

a. Usage: All supply air systems.

H. Boxes shall have pressure independent control capable of controlling with a 0.4" to 3.0" WG pressure drop.

I. Spring ranges and/or failure positions shall be as listed on the drawings or in the Controls section of these specifications.

J. Damper Operators: Furnish all mounting brackets, relays, and linkages. Damper operator shall be provided as follows:

1. Electronic: Provided and installed by the TCC in the field.

K. Electronic Volume Regulator/Controller: Set boxes for maximum and minimum settings shown on the drawings. Electronic volume regulator/controller shall be provided as follows:

1. Provided and installed by the TCC in the field.

L. Refer to control diagrams and notes on control drawings for complete sequence of control.

## 2.3 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX

A. Casing: Minimum 22 gauge galvanized steel.

1. Insulation: Insulation shall be UL listed and meet NFPA 90A requirements. Fully insulated with:

a. Minimum 1/2", minimum 1-1/2 pound density fiberglass insulation.
b. Usage: All supply air systems.

B. Damper Blade: Extruded aluminum or minimum 18 gauge galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfm at 3.0 inches WG inlet static pressure.

C. Inlet Flow Sensor: Provide "cross" □or "ring□" style velocity and static sensor at inlet to box for use by unit controller.

D. Damper Operators: Furnish all mounting brackets, relays, and linkages. Damper operator shall be provided as follows:

1. Electronic: Provided and installed by the TCC in the field.

E. Electronic Volume Regulator/Controller: Set boxes for maximum and minimum settings shown on the drawings. Electronic volume regulator/controller shall be provided as follows:

1. Provided and installed by the TCC in the field.

F. Hot Water Coils: Copper tubes, aluminum fins, minimum 0.016" wall thickness, leak tested at 300 psig. Air pressure drop shall not exceed scheduled value. Provide access door or removable panel for access to the upstream side of the heating coil. Capacity shall be as scheduled on the drawings. Hot water control valve shall be by the TCC.

G. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings. It is the manufacturer's responsibility to increase inlet size to meet pressure drop and N.C. levels scheduled.

H. Refer to control diagrams and notes on control drawings for complete sequence of control.

I. Manufacturers:

1. Carrier
2. Titus
3. Trane
4. Krueger

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Maintain minimum working clear space for all electrical connections in accordance with NFPA 70, National Electrical Code.

C. Provide ceiling access doors or locate units above easily removable ceiling components.

D. Support units individually from structure. Do not support from adjacent ductwork.

E. Where boxes are located adjacent to a wall or joist, the damper motors and control valves shall be located on the side of the box away from the wall or joist to permit easy access.

F. Comb fins on coils to repair bent fins.

G. Insulate terminal air box hydronic reheat coils to prevent condensation. Tape insulation tight to box. Do not insulate or interfere with actuator, access panel and control panel.

### 3.2 ADJUSTING

A. All boxes shall be set to the cfm shown on the drawings. TCC shall be responsible to field recalibrate all boxes that are not set correctly.

**END OF SECTION 233600**

SECT**ION 23 37 00 - AIR INLETS AND OUTLETS**

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grilles And Registers.

B. Square Stepdown Cone Diffusers.

C. Linear Diffusers.

D. Linear Diffuser Supply Plenum.

E. Louvers.

1.2 QUALITY ASSURANCE

A. Test and rate performance of air inlets and outlets per ASHRAE 70.

B. Test and rate performance of louvers per AMCA 500L-99.

C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AMCA 500-L-12 - Laboratory Methods of Testing Louvers for Rating.

B. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. SMACNA - Duct Construction Standards.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00.

B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.

C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.

D. Submit manufacturer's installation instructions.

E. Where color selection by Architect is necessary, provide physical color chips for color selection directly to the Architect. Electronic color charts are not acceptable.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

B. Conform to ASHRAE 90.1.

## PART 2 - PRODUCTS

2.1 AIR TERMINALS - GRILLES AND REGISTERS

A. Reference to a grille means an air supply, exhaust or transfer device without a damper.

B. Reference to a register means an air supply, exhaust or transfer device with a damper.

C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.

D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

E. The capacity and size of the unit shall be as shown on the drawings.

F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to $10^{-12}$ watts with a 10 dB room effect. .

G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.

H. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.

I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.

J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.

K. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.

L. Manufacturers:

1. Tuttle & Bailey
2. Titus
3. Price
4. Metalaire

## 2.2 AIR TERMINALS - SQUARE STEPDOWN CONE DIFFUSERS

A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.

B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.

C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

D. The capacity and size of the unit shall be as shown on the drawings.

E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to $10^{-12}$ watts with a 10 dB room effect. .

F. Diffusers shall be drop face construction.

G. Diffuser shall be entirely constructed of stamped panel and a minimum of three stepdown diffusion cones.

H. Stepdown cones shall be mechanically fastened to panel with metal fasteners. Diffuser stepdown cones glued, fastened with plastic clips, or otherwise attached to face panel will not be acceptable.

I. Each stepdown cone shall be one-piece stamped construction. The cones shall be removable for cleaning.

J. Diffusers shall be constructed of minimum 24 gauge steel.

K. Manufacturers:

1. Tuttle & Bailey
2. Titus
3. Price
4. Metalaire

## 2.3 AIR TERMINALS - SQUARE MODULAR CORE DIFFUSERS

A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.

B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule.

C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to bid date. Submission of bid indicates ceiling and air inlet and outlet types have been coordinated.

D. The capacity and size of the unit shall be as shown on the drawings.

E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to $10^{-12}$ watts with a 10 dB room effect. .

F. Modular core diffusers shall consist of an outer frame assembly to facilitate mounting and shall include an integral square collar to allow connection to the square duct. Where shown on the drawings, the diffuser shall be supplied with a square to round adapter. Flat-oval inlets are not acceptable for connection to flexible ducts.

G. The diffuser core shall consist of fixed louver directional modules that may be field adjusted from the diffuser face without any type of tools or mechanical device for or four-way horizontal discharge airflow.

H. Each louvered module shall be removable to allow access to any damper or other component in or near the diffuser neck.

I. The core's blade spacing shall be 1 inch on center.

J. Manufacturers:

1. Tuttle & Bailey
2. Titus
3. Price
4. Metalaire

## 2.4 AIR TERMINALS - LINEAR DIFFUSERS

A. Linear Bar Grille Diffusers:

1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.
2. The capacity and size of the unit shall be as shown on the drawings.
3. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to $10^{-12}$ watts with a 10 dB room effect per ANSI/ASHRAE 70.
4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings prior to submitting shop drawings.

5. Provide with concealed fasteners for installation in the field.
6. Linear bar diffusers and mounting frames shall be furnished as one piece up to 6' in length. Provide auxiliary support per manufacturer's recommendations for slot diffusers greater than 4' in length.
7. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to each bar grille. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings.
8. Diffuser length and width, bar width, and spacing between bars shall be as shown on the drawings.
9. Provide insulated plenum for each linear diffuser. Refer to linear diffuser supply plenum section for details.
10. Manufacturers:

    a. Tuttle & Bailey 4000
    b. Price LB
    c. Metalaire 2000

## 2.5 LOUVERS - FIXED - ALUMINUM

A. Louvers shall be minimum 4" deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081". Blades shall be spaced at a maximum of 5.1" apart.

B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.

C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.

D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.

E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the Water Penetration Test in AMCA 500-L-07.

F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.

G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.

H. Louvers shall be suitable for duct connection.

I. Manufacturers:

1. Arrow - "EA-415-D"
2. Greenheck - ESD "403"
3. Pottorff - EFD

## PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install items in accordance with manufacturers' instructions.
2. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
3. Install diffusers to ductwork with air tight connections.
4. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.
5. Supply grille and register blades shall be aimed in the field to provide adequate air distribution in the space. All return grilles and registers blades shall be oriented to minimize sight distance beyond installed device.

B. Volume Damper:

1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.

C. Maintaining Duct Cleanliness:

1. When grilles, registers, and diffusers are installed, Contractor shall prevent construction dust, dirt, and debris from entering ductwork as required by Section 23 05 00.

**END OF SECTION 233700**

## SECTION 23 52 16 - CONDENSING BOILERS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Controls and Boiler Trim.

C. Hot Water Connections.

D. Fuel Burning System and Connection.

E. Vent Connection.

F. Boiler Vent Flue.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with at least three years documented experience.

B. Provide factory authorized start-up service by manufacturer's agent.

C. Conform to ANSI/ASME SEC 4 and ANSI/AGA Z21.13 for construction of boilers.

D. Boiler Units: AGA certified, UL listed and ASME certified.

E. Installation shall meet the requirements of ASME CSD-1, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.

F. Conform to ASHRAE 90.1.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ANSI/AGA Z223.1 - National Fuel Gas Code.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/ASME SEC 4 - Boiler and Pressure Vessels Code - Rules for Construction of Heating Boilers.

F. ANSI/ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

G. ANSI/NFPA 70 - National Electrical Code.

H. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

I. NFPA 85 - Boiler and Combustion Systems Hazard Code.

## 1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00.

B. Submit product data indicating general assembly, components, controls, safety controls, and electrical power/controls wiring diagrams, and service connections.

C. Submit manufacturer's installation instructions.

D. Submit reports indicating condition and operation at startup.

E. Submit reports indicating specified performance and efficiency is met or exceeded.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

## 1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data. Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

## 1.7 WARRANTY

A. Division 01 Warranty Requirements apply to boilers unless noted otherwise below. The boiler shall come with the warranties stated below.

1. Lifetime, shockproof warranty on seal of tube to header. Covers leaks in pressure vessel attributed to unequal expansion.
2. All heat exchangers shall carry a 10-year limited warranty.
3. Pressure vessel and flue collector shall carry a 5-year limited warranty against failure due to flue gas corrosion.
4. Burner shall carry a 5-year limited warranty.
5. All other parts shall carry a 1-year limited warranty.

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. Provide factory assembled, factory fire-tested, self-contained unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Hot water, condensing type boiler with integral forced draft or pulse combustion burner, burner controls, boiler trim, insulation and jacket.

C. ASME allowable working pressure of 150 psig water.

D. Provide two lifting eyes on top of boiler.

E. Unit casing shall be a minimum of 16 gauge steel. Factory paint boiler, base, and other components with hard finish enamel.

F. Porcelain enameled or stainless steel exhaust manifold with gravity drain and reservoir for condensate elimination.

### 2.2 SINGLE FUEL BOILER

A. Fire Tube Stainless Steel:

1. System Design: Primary-secondary with external primary pumps.
2. Minimum Efficiency AHRI Rated (at 120F Return Water Temp): 95% (92%).
3. Fuel Burning System – Single Fuel:

    a. Fuel Type: Natural gas.
    b. General: Forced draft automatic burner integral with boiler designed to burn natural gas at 8.5" to 14" WC inlet pressure. Maintain fuel-air ratios automatically.
    c. Gas Burner: Forced draft, power burner with interrupted spark ignition and flame sensor. Low NOx <20ppm.

4. Heat Exchanger: Stainless steel water tube ASME Section IV H stamp.
5. Capacity Control and Turndown: Staged minimum 20:1.
6. Pump: External primary pump. Refer to project schedules.
7. Acceptable Manufacturers:

    a. Aerco Benchmark
    b. Camus Avenger
    c. Lochinvar Crest

### 2.3 HOT WATER BOILER TRIM

A. Provide ASME safety relief valve set at 125 psi or boiler maximum allowable working pressure.

B. Provide low water cutoff with manual reset to automatically prevent burner operation whenever boiler water falls below safe level.

C. Provide operating temperature controller to control burner operation to maintain boiler water temperature, as determined by a remote 4-20 mA signal from building DDC system or boiler controller.

D. Limit temperature controller to control burner to prevent boiler water temperature from exceeding safe system water temperature.

## 2.4 FUEL BURNING SYSTEM - SINGLE FUEL

A. General: Forced draft automatic burner integral with boiler designed to burn natural gas at 8.5" to 14" W.C. inlet pressure. Maintain fuel-air ratios automatically.

B. Gas Burner: Forced draft, power burner with interrupted spark ignition and flame sensor.

C. Natural Gas Burner Piping: Provide all trim required to meet ASME CSD-1. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls. Include pressure regulators, safety and operating valves, high and low-pressure switches, main shutoff valve, gas pressure gauge, and airflow safety switch. Vent all gas valves outdoors separately.

D. Burner to be modulating with a minimum turndown ratio as defined above.

## 2.5 CONTROLS

A. The boiler system control panel shall include contacts for a trouble alarm to the DDC system.

B. Program relay to control ignition, starting and stopping of burner and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition or main flame failure. Interlock to shut down burner upon combustion air pressure drop.

C. Manual-automatic selector switch to permit automatic firing in accordance with load demand, or manual control of firing rate at fixed temperature.

D. Panel to include indicating lights to show fault conditions of low water level, flame failure, fuel pressure, exhaust temperature, water temperature, or combustion air pressure. Mount indicating lights and switches in hinged drop-panel for access to wiring.

E. The boiler system control panel shall include contacts for a manual emergency shutdown switch. The switch shall be furnished, installed, and wired by the Mechanical Contractor. A switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation.

F. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read "BOILER EMERGENCY SHUTOFF". Square D XAL K174 or as approved by Architect/Engineer.

G. For multiple boiler systems, furnish a boiler management system consisting of controller(s) capable of stopping, starting, and modulating all boilers to maintain maximum efficiency of the boiler plant. The boiler management system shall include all alarms, control points, and setpoints specified.

H. Manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135. This may be accomplished through a system integration panel or "gateway". Integration panels shall be provided as part of the boiler package. Wiring between the boiler control panel(s) and the integration panel shall be the responsibility of the manufacturer.

## 2.6 BOILER FLUE

A. Stainless Steel (AL29-4C):

1. The venting system shall be ANSI/UL 1738.
2. The venting system shall be double wall metal with a minimum of 1" air space between the walls. Outer wall shall be Type 430 stainless steel.
3. The inner pipe shall be AL29-4C.
4. Vent flue pipe shall be UL listed for Category III and IV appliances with operating temperatures of up to 480F. The closure system to be rated as gas tight for 5" w.c. positive pressure flue gas service.
5. Fasteners to be same material as piping and shall maintain 1" air space between walls.
6. The joints shall be gas tight to prevent leakage of flue or condensate.
7. Vent system is to be sized in accordance with manufacturer's recommendations and the current edition of NFPA 54/ANSI Z223.1: National Fuel Gas Code and ASHRAE recommendations.
8. Furnish wall termination kit.
9. Usage: Condensing and high efficiency boiler positive pressure gas vent and combustion air intake.

B. Chlorinated Polyvinyl Chloride Piping (CPVC):

1. Type BH Class IIB Vent.

2. Vent flue pipe shall be UL listed for Category IIB appliances with operating temperatures of up to 195F. The closure system to be rated as gas tight for 5" w.c. positive pressure flue gas service.
3. Tubing: Virgin rigid chlorinated polyvinyl chloride (CPVC). Copper tube size (CTS) manufactured to standard dimensional ratio (SDR) 11, ASTM D1784: ASTM D2846, NSF Certified.
4. Joints: Solvent cement and primers shall be certified for flue gas venting applications.
5. Fittings: Same as tubing. Fittings and tubing shall be a system provided by the same manufacturer. Threaded adapters for threaded valves shall be metal threaded adapter with solvent socket.
6. Limitations: Shall not be used in a return air plenum unless specifically listed to ASTM E84/UL723.
7. Vent system is to be sized in accordance with manufacturer's recommendations and the current edition of NFPA 54/ANSI Z223.1: National Fuel Gas Code and ASHRAE recommendations.
8. Usage: Condensing and high efficiency boiler combustion air intake and vent. Include boiler manufacturer's written approval for use as a vent material.
9. Furnish wall termination kit.

C. Polyvinyl Chloride Piping (PVC):

1. Tubing: Schedule 40 rigid PVC, normal impact Type l, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.
2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.
3. Fittings: Same as tubing. PVC, normal impact Type l, with solvent-weld socket type ends for Schedule 40 pipe.
4. Limitations: Shall not be used in a return air plenum unless specifically listed to ASTM E84/UL723.
5. Intake system is to be sized in accordance with manufacturer's recommendations and the current edition of NFPA 54/ANSI Z223.1: National Fuel Gas Code and ASHRAE recommendations.
6. Usage: Boiler combustion air intake only. PVC shall not be permitted for use with any boiler venting.
7. Furnish wall termination kit.

D. The boiler manufacturer shall furnish all vent flue piping, fittings, dampers, and accessories as required to properly vent the equipment. Vent piping shall be UL listed for use with Category III and IV appliances with operating temperatures of up to 480F.

## 2.7 ACID NEUTRALIZATION KIT

A. Provide neutralization kit for condensate discharge including neutralization agent, means for visual inspection, all accessories, and piping connections and neutralization media. Kit shall be sized by the manufacturer to match the boiler size(s) provided.

2.8 ELECTRICAL

A. Provide single-point electrical connection for the boiler and controller. Separate power wiring and control wiring is not acceptable. Refer to schedules for power requirements.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements:

1. Install in accordance with manufacturer's instructions.
2. Provide for connection to electrical service.
3. Provide connection of gas service in accordance with ANSI/AGA Z223.1.

B. Combustion Inlet and Venting:

1. Provide complete sealed combustion inlet and venting system.
2. Slope all horizontal runs of exhaust vent towards the boilers at a slope of 1" per 4'.
3. Route flue condensate to neutralization kit with acid resistant piping.

C. Fuel Piping:

1. Install piping in accordance with manufacturer's installation instructions. Provide minimum 10 ft pipe distance between gas pressure regulator and gas train or distance as dictated by manufacturer.
2. Provide connection of gas service in accordance with ANSI/AGA Z223.1.
3. Provide readily accessible natural gas manual shutoff valve within 6ft of boiler.
4. Vent all gas valves/regulators to outdoors separately.
5. Pipe safety relief valve to nearest floor drain.

D. Service Clearances:

1. Install the boilers with a minimum of three feet clear space behind them for installation of piping and services. Verify exact maintenance clearances required by the manufacturer prior to installation.

E. Neutralization Kit:

1. Install neutralization kit per manufacturer's recommendations. Piping between boiler, flue, and kit shall be acid resistant piping material suitable for greater than 140F or per manufacturer recommendations.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under factory authorized supervision.

B. Provide field representative for starting unit and training operator.

C. Provide combustion test and submit report. Test shall include boiler firing rate, overfire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen ($O_2$), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent combustion efficiency, and heat output.

**END OF SECTION 235216**

## SECTION 23 62 13 - AIR COOLED CONDENSING UNITS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Condensing Unit Package.

B. Charge of Refrigerant and Oil.

C. Refrigerant Circuit.

D. Motor Starters.

E. Electrical Power Connections.

1.2 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/UL - Safety for Heating and Cooling Equipment.

C. AHRI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

D. ASHRAE 23 - Methods of Testing for Rating Positive Displacement Condensing Units.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00 indicating components, assembly, dimensions, weights and loadings, required clearances, location and size of field connections, rated capacities, and electrical nameplate data. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system. Piping diagrams shall apply specifically to this job. Include description of capacity control logic and interface with building control system.

B. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

C. Submit operation and maintenance data including start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units on site from physical damage. Protect coils.

1.5 WARRANTY

A. Provide a one-year parts and labor warranty. Compressors shall have an additional four year warranty covering all material and labor costs for compressor repair or replacement at the Owner's option.

**PART 2 - PRODUCTS**

2.1 MANUFACTURED UNITS

A. Units: Self-contained, packaged, factory assembled and wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.

B. Construction and Ratings: In accordance with AHRI 210/240 and ANSI/UL 207 and 303. Testing shall be in accordance with ASHRAE 14.

C. Performance Ratings: EER and COP meeting ANSI/ASHRAE 90.1.

2.2 CASING

A. House components in welded steel frame with galvanized steel panels with painted finish meeting ASTM B117 salt spray test standard.

B. Mount starters, disconnects, and controls in weatherproof panel with full opening access doors.

C. Provide gasketed removable access doors or panels with quick fasteners.

2.3 CONDENSER COILS

A. Aluminum fins mechanically bonded to seamless copper tubing. Provide 12F of refrigerant subcooling at design conditions.

B. Coil Guard: Painted expanded metal or PVC coated steel wire.

C. Provide hail guards on all condenser coils.

2.4 CONDENSER FANS AND MOTORS

A. Vertical discharge direct drive propeller type condenser fans with fan guards.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in thermal overload protection.

C. Dynamically and statically balanced fans.

D. Separate motors for each fan.

## 2.5 COMPRESSORS

A. Construction: Semi-hermetic or hermetic scroll type with suction and discharge valves.

B. Mounting: Dynamically balance rotating parts and mount on vibration isolators.

C. Lubrication System: Oil pump with oil charging valve, oil level sight glass, oil filter, and magnetic plug or strainer.

D. Capacity Reduction Equipment: Multiple compressors, and/or multi-speed or variable-speed compressors.

E. Motor: Suction gas cooled with electronic sensor and winding over temperature protection.

F. Crankcase Heater: Evaporates refrigerant in crankcase during shutdown.

G. Suitable for operating on voltages plus or minus 15% of nameplate ratings.

## 2.6 REFRIGERANT CIRCUIT

A. Refrigerant may be new or reclaimed, and shall meet ARI-700-2004 Standard for Refrigerant Purity.

B. Provide each unit with the number of refrigerant circuits needed to provide the scheduled unloading and properly transport oil.

C. Provide the following for each refrigerant circuit:

1. Replaceable core type filter dryer.
2. Liquid line sight glass and moisture indicator.
3. Thermal expansion valve.
4. Insulated suction line.
5. Suction and liquid line service valves.
6. Schraeder valve.
7. Condenser pressure relief valve.
8. Suction filter.
9. Liquid line solenoid valve.

D. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control using thermistors.

E. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comb all condenser coils to repair bent fins.

C. Install on vibration isolators as scheduled on the drawings or in Section 23 05 48.

D. Connect to refrigeration piping and evaporators.

### 3.2 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up by factory authorized service representatives. Adjust units to provide proper superheat.

B. Supply initial charge of refrigerant and oil for each refrigerant circuit. Replace losses of refrigerant and oil during the warranty period.

**END OF SECTION 236213**

## SECTION 23 64 30 - AIR COOLED WATER CHILLERS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Chiller Package.

B. Charge of Refrigerant and Oil.

C. Controls and Control Connections.

D. Connections.

E. Starters.

F. Sound Reduction Package

1.2 REFERENCES

A. ANSI/AHRI 590 - Standard for Water Chilling Packages using the Vapor Compression Cycle.

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code

E. ANSI/NEMA MG 1 - Motors and Generators.

F. ANSI/UL 1995 - Heating and Cooling Equipment.

G. ANSI/UL 984 - Safety Standard for Hermetic Motor Compressors.

H. ANSI/AFBMA 9 - Load ratings and Fatigue Life for Ball Bearings.

I. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.

J. AHRI 550 - Centrifugal or Rotary Water - Chilling Packages.

K. ARI-700-99 - Specification for Fluorocarbon Refrigerants.

## 1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00 indicating components, assembly, dimensions, weights and loadings, required clearances, location and size of field connections, valves, strainers, thermostatic valves, rated capacities, specialties, accessories, electrical requirements and electrical power/control wiring diagrams.

B. Submit manufacturer's installation instructions, including startup service reports and warranty.

C. Submit operation data, start-up instructions, maintenance data, parts lists, controls, accessories, and trouble-shooting guide. Operation data shall include emergency, operation, and maintenance manuals.

D. Submit AHRI Standard 370 sound power octave band data at 25%, 50%, 75%, and 100% load.

E. Submit AHRI certified performance data indicating energy input versus cooling load output from minimum operating capacity to 100% of full load.

## 1.4 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. Protect insulation from dust, debris, and/or damage.

C. Unit controls shall be capable of withstanding 150F storage temperatures for an indefinite period of time.

## 1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing of the products specified in this Section with minimum five years' experience.

B. All manufacturers shall have factory authorized and trained service personnel within 180 miles of the project site.

## 1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/AHRI 590, ANSI/UL 1995, ANSI/ASME SEC 8 Boiler and Pressure Vessel Code, ANSI/UL 984, and ANSI/ASHRAE 15.

B. Conform to ASHRAE 90.1.

1.7 WARRANTY

A. Provide five year compressor warranty covering materials and labor cost for repair or replacement at the Owner's option.

B. Provide one year warranty on the entire unit covering materials and labor cost for repair or replacement of defective components at the Owner's option.

1.8 MAINTENANCE SERVICE

A. Chiller manufacturer or chiller certified representative shall furnish service and maintenance of complete assembly for one year from Date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Basis of Design: The scheduled manufacturer is the Basis of Design. The Contractor is responsible for all costs, schedule impacts, and construction coordination, including design costs and regulatory agency approvals, related to using a specified alternate product other than the Basis of Design. Refer to Section 23 05 00 for additional information.

B. Trane.

C. York.

D. Daikin.

E. Carrier.

2.2 AIR COOLED WATER CHILLERS

A. Provide factory assembled and tested outdoor air cooled liquid chillers consisting of compressors, condenser, fans, evaporator, thermal expansion valve, refrigeration accessories, and control panel.

B. Evaporator tubes are designed to operate under constant water flow conditions. Chiller manufacturer shall determine the minimum flow rates and maximum rate of water flow rate change. Coordinate with the Controls Contractor.

C. Provide chiller with automatic capacity control down to scheduled minimum capacity.

D. Units shall have efficiency meeting ASHRAE 90.1.

E. Charge unit with refrigerant at the factory and provide field charging if required after installation.

## 2.3 COMPRESSORS

A. Hermetic direct drive scroll compressor(s) with suction strainer, crankcase oil heater, and suction and discharge valves.]

B. Statically and dynamically balance rotating parts. Mount on internal vibration isolators.

C. Provide oil charging valve, oil level sight glass, oil filter, and magnetic plug on strainer, arranged to ensure adequate lubrication during starting, stopping, and normal operation.

D. Provide reciprocating compressors with suction valve unloaders with lifting mechanism operated by solenoid valve. Provide for unloaded compressor start.

E. Provide compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection.

F. Provide compressor heater to evaporate refrigerant returning to compressor during shut down. Energize heater when compressor is not operating.

## 2.4 EVAPORATOR

A. The evaporator shall be a dual circuit, brazed plate heat exchanger consisting of parallel stainless steel plates with copper as the braze material.

B. Evaporator shall be UL listed.

C. Design, test, and stamp refrigerant side for the applicable refrigerant working pressure and water side for 150 psi working pressure in accordance with ANSI/ASME SEC 8.

D. Evaporator shall be insulated with closed cell insulation with a minimum R-value of 3.0.

E. Provide thermostatically controlled heaters to protect to -20F ambient in off-cycle.

F. Provide drain and vent connections in the chilled water piping to allow proper drainage and venting of the heat exchangers. Provide thermometer wells for temperature controller and low temperature cutout.

G. Install a 40 mesh strainer upstream of each heat exchanger.

H. Evaporator shall have ANSI/AWWA C-606 grooved 150 psi flange water inlet and outlet connections.

I. Provide valved differential pressure gauge between supply and return at evaporator.

J. Provide differential pressure flow switch or thermal dispersion flow switch in evaporator piping with connection to chiller control panel to provide proof of flow. Flow switch shall be factory installed and wired for internal evaporators.

## 2.5 CONDENSERS

A. Condenser shall provide design capacity between the minimum and maximum ambient conditions scheduled on the drawings.

B. Condenser Coil:

1. Round Copper Tube and Aluminum Fins: Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing. Air test underwater to 450 psig.
2. Microchannel: All aluminum brazed fin construction. The maximum allowable working pressure of the condenser is 450 psig. Air test underwater to 450 psig. Coils and frame shall include 5000+ hour salt spray resistance (ASTM B117-90).

C. Condenser Fans: Provide vertical discharge propeller condenser fans with fan guard on discharge. Entire fan assembly shall be statically and dynamically balanced.

D. Condenser Fan Motors: (as scheduled on drawings):

1. Induction: Furnish permanently lubricated sealed ball type motor and drive shaft bearings. Motor and wheel supported by vibration isolators.
2. Electronically Commutated Motor (ECM): Motor shall be variable speed, constant torque, brushless permanent magnet (PM) motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall include integral surge protection. Motor and controller shall be pre-wired for specific voltage and phase. Motor frame shall be NEMA 48; All EC motors shall be a minimum of 85% efficient at all speeds. Provide motor with onboard motor control module. Motor speed shall be limited to provide electronic overcurrent protection. Provide with thermal overload protection, factory mounted and wired disconnect. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed.

E. Condensor Coil Guard: Factory mounted galvanized steel louvered panels or wire mesh panels to protect condenser coils.

## 2.6 ENCLOSURES

A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.

## 2.7 REFRIGERANT CIRCUIT

A. Provide refrigerant circuits, factory supplied and piped.

B. Provide for each refrigerant circuit:

1. Liquid line solenoid and shutoff valves.
2. Filter dryer (replaceable core type).
3. Liquid line sight glass and moisture indicator.

4. Electronic or thermal expansion valve.
5. Charging valve.
6. Insulated suction line.
7. Discharge and oil line check valves.
8. Compressor suction and discharge service valves.
9. Condenser pressure relief valve.
10. Refrigerant and oil.

C. Refrigerant may be new or reclaimed. Reclaimed refrigerant shall meet the ARI-700-99 Specification for Fluorocarbon Refrigerants.

D. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

## 2.8 CONTROLS

A. On chiller, mount lockable weatherproof steel control panel, containing starters, power and control wiring, non-fused disconnect switch, factory wired with single point power connection. Provide mechanical interlock to disconnect power when door is open.

B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for control power. Provide manual reset current overload protection.

C. Provide the following safety controls with 40-character English display, arranged so any one will shut down machine and require manual reset:

1. Low chilled water temperature switch.
2. High discharge pressure switch[ for each compressor].
3. Low suction pressure switch[ for each compressor].
4. Oil pressure switch.
5. Flow switch in chilled water line.
6. Motor current overload.
7. Phase reversal/unbalance/single-phasing.
8. Over/under voltage.
9. Failure of water temperature sensor used by chiller controller.
10. Relay for remote mounted emergency shut-down switch.
11. Low ambient/high ambient.

D. Provide the following operating controls:

1. Chilled water temperature controller[ that modulates capacity control device(s)].
2. Timer to prevent compressor short cycling.
3. Anti-coincidental timer.
4. Timer to pump down on high evaporator refrigerant pressure.
5. Load limit thermostat to limit compressor loading on high return water temperature.
6. Low ambient control for operation down to 0F.
7. High ambient controls for operation over 115F.

E. Microprocessor control panel with digital readout. Display shall be multiple character LCD or lighted display with keypad.

1. User interface shall display at a minimum the following:

a. Operating/alarm condition.
b. Leaving chilled water temperature set point (with adjustment at the panel[ and][ via DDC]).
c. Entering and leaving chilled water temperature.
d. Percent rated load amps output for each compressor.
e. Condenser pressure for each circuit.
f. Evaporator pressure for each circuit.
g. Outside air temperature.
h. Voltage.

2. Control panel shall communicate the following points to the DDC system via a Lon, Modbus or BACnet interface:

a. Inputs:

1) Chiller enable.
2) Leaving chilled water temperature set point.
3) Chiller mode.
4) Current limit set point.

b. Outputs:

1) Chiller status.
2) Active chilled water set point.
3) Leaving chilled water temperature.
4) Entering chilled water temperature.
5) Alarm descriptor.
6) Average percent Run Load Amps (actual capacity).
7) Active current limit set point.

F. For multiple units, provide mounted sequence panel for operation in series with lead lag switching.

G. Chiller manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135/2001. This may be accomplished through a system integration panel, or "gateway". Integration shall be through an RS-232 connection. Integration panels shall be provided as part of the chiller package. Wiring between the chiller control panel(s) and the integration panel shall be the responsibility of the chiller manufacturer.

## 2.9 BEARINGS

A. All bearings shall have a L10 life of not less than 200,000 hours per ANSI/AFBMA 9.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. General Installation Requirements:

1. Install in accordance with manufacturer's instructions.
2. Align chiller package on steel or concrete foundations.
3. Install on vibration isolators as scheduled on the drawings or in Section 23 05 48.
4. Comb all condenser coils to repair bent fins.
5. Provide a coated wire mesh that covers the access area underneath the condenser coils.

B. Piping Requirements:

1. Connect to chilled water piping. On inlet, provide well for temperature controller, well for temperature limit controller and well for thermometer, flexible connector and shutoff valve. On outlet, provide well for thermometer, flexible connector, shutoff valve, control valve and balancing valve.
2. Arrange piping for easy dismantling for tube cleaning. Install flow switch in piping at remote evaporator and wire to chiller control panel.

C. Paint Requirements:

1. Paint chiller completely (including insulation) including two coats of paint to insulation or PVC jacketing. Provide one pint of additional paint for touch-up after installation. Color selection by Architect.

### 3.2 MANUFACTURER'S FIELD SERVICES

A. Provide factory trained representation for a period of one day to perform testing, start up, and instruction on operating and maintenance to Owner.

**END OF SECTION 236430**

## SECTION 23 73 13 - INDOOR MODULAR AIR HANDLING UNITS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modular Indoor Handling Units.

1.2 QUALITY ASSURANCE

A. AHU Unit: Manufacturer specializing in design and manufacturing of the products specified in this section with a minimum of five years' experience.

B. Fabrication: Conform to AMCA 99 and AHRI 430.

C. Fan Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

D. Sound Ratings: Tested to AMCA 300.

E. Fan Energy Index (FEI): Fans shall meet or exceed the minimum FEI scheduled at the specified airflow, pressure, and air density (duty point). In no case shall the FEI at the specified duty point fall below 1.0.

F. Air Coils: Certify capacities, pressure drops, and selection procedures per AHRI 410.

G. Electrical control wiring shall be in accordance with NEC codes and ETL requirements.

H. Unit shall contain only UL listed components.

I. Conform to ASHRAE 90.1.

J. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AMCA 208 - Calculation of the Fan Energy Index (FEI).

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

D. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters

E. AMCA 99 - Standards Handbook.

F. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

G. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

H. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

I. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

J. AHRI 430 - Standard for Central-Station Air-Handling Units.

K. ASHRAE/ANSI Standard 111 - Practices for Measurements, Testing, Adjusting and Balancing Heating, Ventilating, Air-Conditioning and Refrigeration Systems.

L. NFPA 70 - National Electrical Code.

M. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

N. SMACNA - HVAC Duct Construction Standards (latest edition).

O. Standard 62-2004 - Ventilation for Acceptable Indoor Air Quality (ANSI Approved).

## 1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Indicate ratings, fan performance, motor electrical characteristics, gauges, material finishes, assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

1. Product Data

a. Include data on all fans and accessories. Submit motor ratings and electrical characteristics, plus motor and electrical accessories. Submit multi-speed fan curves including minimum and maximum fan speed with specified operating points clearly plotted. Submit the Fan Energy Index (FEI) at the selected duty point.
b. Select fans using external static pressure noted in the schedule. Manufacturer responsible for calculation of internal static pressure. Manufacturer shall include an allowance for clean filters in the internal static pressure. An allowance for the difference between dirty filters and clean filters is included in the external static. Submit static pressure calculations showing total pressure drops, including tabulated internal pressure drops and specified external static pressure drops
c. Submit sound power level data for both fan outlet and casing radiation at rated capacity.
d. Submit shop drawings indicating coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions
e. Submit manufacturer's data showing that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.
f. Provide a copy of data of filter media, filter performance data, filter assembly, and filter frames with unit submittal for reference only.

B. Submit manufacturer's installation instructions.

C. All base bid pricing shall be based on the drawings, schedules and this specification

1. If a manufacturer requests to deviate from the requirements described herein, the Manufacturer and/or Contractor may list voluntary add or deduct prices on the bid form. These voluntary prices will not be used in determining the low bidder.
2. All voluntary adds or deducts shall be discussed and agreed to by the Owner and Architect/Engineer prior to the award of the air handling unit bid and before the submittal process begins.

D. Any exceptions to the specifications must be clearly noted to the Architect/Engineer prior to acceptance. Contractor is responsible for all expenses due to exceptions.

E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

F. Submit operation and maintenance data. Include instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists.

## 1.5 EXTRA STOCK

A. Provide clean filters in all units at time of installation.

B. Provide clean filters in all units at project final completion after all interior finishes are complete.

C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site with protective coverings in-place. Loose shipped items must be in factory-provided protective coverings, with factory-installed shipping skids and lifting lugs.

B. Store unit in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

## 1.7 WARRANTY

A. Provide a manufacturer's 1-year parts and labor warranty against defects in material and workmanship.

## 1.8 GENERAL DESCRIPTION

A. Unit Location:

1. The air handling unit is a variable air volume modular unit, located on floor.
2. The unit will be set on a concrete housekeeping pad by the Contractor.

B. Building Type:The building is a steel structure with a cast-in-place concrete floor system on steel bar joists.

C. Unit Description:

1. The unit shall contain all the components described in these specifications and shown on the drawings and schedules.
2. Refer to air handling unit drawings and schedules for additional information

## PART 2 - PRODUCTS

### 2.1 MODULAR INDOOR AIR HANDLING UNITS

A. Manufacturers

1. Trane
2. Daikin
3. Carrier
4. JCI/York
5. Scott Springfield

B. Unit Casing:

1. Minimum 18 gauge G60 galvanized steel exterior panels reinforced and braced with galvanized steel framework.
2. Removable access panels for coil and fan removal.
3. Unit shall be double wall insulated constructed panel. Exterior wall shall be minimum 18 gauge galvanized steel. Interior wall shall be minimum 20 gauge solid galvanized steel. Cover all portions of the interior of the unit exposed to the airstream with steel to allow cleaning and prevent fiberglass erosion into the airstream. Foil facing on insulation shall not be acceptable as a substitute for double wall construction. If casing sections are not provided by the unit manufacturer with double wall construction, the Contractor is responsible for covering exposed insulation with galvanized sheet metal. The minimum R-value of the panel assemblies shall be 8. Roof and wall panels downstream of cooling coil shall include thermal break design with no through metal penetrations.
4. Install a stainless steel drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.
5. Units shall be draw-thru or blow-thru as noted on the drawings and shall not exceed the overall dimensions.Doors:

1. Unit doors shall be double wall and insulated with the same materials used in the surrounding unit walls.Doors downstream of cooling coil shall include thermal break design with no through metal penetrations.
2. Doors shall contain a continuous neoprene bulb type gasket.
3. Each door shall contain a double pane tempered, reinforced or safety glass window.
4. Each door shall have a minimum of two (2) high compression type latches, operable from both sides.
5. Provide minimum 12" x 18" hinged access doors on both sides of the fan housing.
6. Unit shall have full height, galvanized, double wall, and hinged, removable access doors on both sides of fan.

D. Access Sections:

1. Provide access sections as shown on the drawings between unit sections. Provide access doors as shown on plans..

E. Fan:Direct Drive Single Width, Single Inlet Plenum Multi-fan Array with Airfoil Blades:

a. Fan RPM shall not exceed 110% of scheduled value with the scheduled wheel type.
b. Statically and dynamically balanced.
c. Grease lubricated ball bearings, selected for 200,000 hours L-50 life at the design operating conditions.
d. Factory balanced fans will be used with variable speed controls to operate at all speeds up to the design speed.
e. Fan(s) shall have internal spring isolators.
f. Multiple fan arrays shall be provided with gravity backdraft dampers on each fan inlet.

2. Double Width, Double Inlet Centrifugal Fan(s), with Forward Curved Blades:

a. Fan RPM shall not exceed 110% of scheduled value with the scheduled wheel type. Substitution of BI or BIA fans for FC is acceptable if efficiency is not lower.
b. Statically and dynamically balanced.
c. Grease lubricated ball bearings, selected for 200,000 hours L-50 life at the design operating conditions.
d. Provide extended lubrication lines for all bearings to an easily accessible location.
e. Provide approved belt guards with openings for tachometer readings for external drives only.
f. Factory balanced fans will be used with variable speed controls to operate at all speeds up to the design speed.
g. Fan(s) shall have internal spring isolators.
h. Multiple fan arrangements shall be provided with gravity backdraft dampers on each fan.

F. Motors and Drives:

1. AC Induction Motors:

    a. Motors shall have slide rails, adjusting screws, anchor bolts and bedplates.
    b. Motor mounting bracket shall be adjustable to allow tightening of belts.
    c. Motors shall be open drip-proof or TEFC type with grease lubricated bearings.
    d. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.
    e. Drives shall be V-belt type with adjustable pitch sheaves for units 20 HP and below. On units over 20 HP, use fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.
    f. No equipment shall be selected or operate above 90% of its motor nameplate rating.

2. Electronically Commutated Motors (ECM):

    a. Motor shall be variable speed, constant torque, brushless DC motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall integral surge protection. Motor shall be pre-wired for specific voltage and phase.

        1) Motor frame shall be NEMA 48. UL recognized components shall be provided for the motor construction.

    b. All EC motors shall be a minimum of 85% efficient at all speeds.
    c. Motors shall be permanently lubricated, utilize ball bearings to match with the connected driven equipment.
    d. Provide motor with on-board motor control module. Motor speed shall be limited to provide electronic overcurrent protection. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed.

3. Variable Frequency Drives: Refer to Section 23 05 15 for requirements.

G. Coils:

1. Hot Water Coils:

    a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.
    b. Suitable for continuous operation at 200 psi. Maximum air velocity of 1000 fpm.
    c. Galvanized steel casing. Coil headers and U-bends shall not be exposed.
    d. AHRI rated with 0.0005 tube side fouling factor.
    e. Size coils sized based on EWT, EAT, gpmand cfm as scheduled. LAT shall be at least as high as scheduled. APD and WPD shall not exceed scheduled values.
    f. Maximum 144 fins per foot.
    g. Coils shall have drain and vent connections at supply and return headers with valves. Extend valving outside of the unit casing.

h. Install coils level to allow drainage.
i. Minimum 0.024" tube wall thickness.
j. Manufacturers:

1) Trane
2) York
3) Carrier
4) Scott Springfield
5) Daikin

2. Chilled Water Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.
b. Stainless steel casing. Coil headers and U-bends shall not be exposed.
c. Maximum air velocity of 550 fpm.
d. AHRI rated with 0.0005 tube side fouling factor.
e. Coils shall be sized based on EWT, EAT, gpm and cfm as scheduled. The leaving DB, leaving WB, APD and WPD shall not exceed the scheduled values.
f. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.
g. Suitable for 200 psig operation.
h. Coils shall have drain and vent connections at supply and return headers. Install coils level for proper drainage. Coils shall be completely drainable. Minimum 1/2" OD tubes. Minimum 0.024" tube wall thickness.

H. Mixing and Filter Section:

1. Provide with a mixing box and a separate angled filter section. Damper arrangement shall be as shown on the drawings. Furnish dampers with the unit. Dampers shall be extruded aluminum with 6" airfoil blades, compressible metal jamb seals, molded synthetic or stainless steel sleeve bearings. The damper shall not leak more than 4 cfm/sq.ft. at 1" W.C. as tested per AMCA Standard 500-D-98. Maximum damper size shall be 48" in length. Provide multiple damper sections for larger lengths. Multiple dampers shall use individual actuators. Jackshafting is not acceptable. Filters shall be as scheduled and have full size hinged access doors.
2. Reference Section 23 40 00 for filter requirements.

I. Electrical Power:

1. Provide factory-mounted, vapor-tight light fixtures in each accessible section of the unit. The fixture shall be complete with junction box, globe, aluminum globe guard, switch, and bulb. Lighting shall be wired to a single 120-volt point, terminating at a designated junction box mounted on the air-handling unit. The Mechanical Contractor is responsible to complete all wiring connection between shipping splits after assembly.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. General Installation Requirements

1. Install per manufacturer's instructions.
2. During construction provide temporary closures of metal or taped polyethylene over openings into casing ducts to prevent dust from entering ductwork.
3. Seal all contractor installed penetrations airtight. Seal all openings prior to cleaning. Seal holes with proper SMACNA closures conforming to pressure class of the casing.
4. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. Coil Requirements:

1. Comb all coils to repair bent fins.
2. Extend coil drain and vent connections to outside unit casing. Provide normally closed valve on drain and vent connection outside of unit casing.

### 3.2 MANUFACTURER'S FIELD SERVICES

A. Provide factory authorized field representative for starting unit and training operator.

B. Prepare and start systems with installing contractor observation.

**END OF SECTION 237313**

## SECTION 23 81 26 - SPLIT SYSTEM AIR CONDITIONING UNITS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Split system heat pump, air conditioning, wall units.

1.2 REFERENCES

A. ARI 210 - Unitary Air Conditioning Equipment

B. ARI 240 - Air Source Unitary Heat Pump Equipment

C. ANSI NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

D. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

F. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. ASTM B1003 - Standard Specification for Seamless Copper Tube for Linesets.

H. UL - Underwriters' Laboratories.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Indicate drain, electrical, and refrigeration rough-in connections on shop drawings or product data.

C. Submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

B. Comply with manufacturer's installation instruction for rigging, unloading, and transporting units.

C. Protect units from weather and construction traffic by storing in dry, roofed location until units are ready for immediate installation.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A for the installation of computer room air conditioning units.

B. Conform to ASHRAE 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.7 WARRANTY

A. Provide five (5) year manufacturer's warranty on all compressors.

**PART 2 - PRODUCTS**

2.1 SPLIT SYSTEM WALL AND CEILING-MOUNTED UNITS

A. Manufacturers:

1. Carrier/Toshiba
2. Samsung
3. Daikin Applied
4. Trane/Mitsubishi

B. Manufactured Units:

1. Provide packaged, air-cooled, factory assembled, pre-wired and pre-piped unit consisting of cabinet, fans, filters, remote condensing unit, and controls. Wall-mounted units shall be furnished with integral wall mounting bracket and mounting hardware.
2. Assemble unit for wall-mounted or ceiling installation with service access required.
3. Performance shall be as scheduled on the drawings.
4. Unit shall be rated per AHRI Standards 210/240 and listed in the AHRI directory as a matched system.
5. Provide unit with factory-supplied cleanable air filters.
6. The units shall be listed by Electrical Laboratories (ETL) in accordance with UL-1995 certification and bear the ETL label.
7. All wiring shall be in accordance with the National Electric Code (NEC).

C. Evaporator Cabinet and Frame:

1. Cabinet:

    a. Refer to schedule on drawings for mounting type (wall-mounted).
    b. Exposed units shall have a finished appearance with concealed refrigerant piping, condensate drain piping, and wiring connections.

D. Evaporator Fans and Motors:

1. Fans:

    a. The evaporator fan shall be direct drive with a single motor having permanently lubricated bearings.
    b. The fan shall be statically and dynamically balanced.
    c. The indoor fan shall have at least three speeds.

2. Motor:

    a. Direct driven, digitally controlled with multiple speeds. Permanently lubricated with internal overload protection.

E. Evaporator Coils (Direct Expansion):

1. Direct expansion cooling coil of seamless copper tubes expanded into aluminum fins.
2. Single refrigeration circuit with externally equalized expansion valve.
3. Coils shall be pressure tested at the factory.
4. A sloped, corrosion-resistant condensate pan with drain shall be provided under the coil.

F. Electrical Panel:

1. Service Connections, Wiring, and Disconnect Requirements: Conform to the National Electrical Code and local electrical codes.

G. Control:

1. The unit shall have a hard-wired 7-day programmable remote controller to operate the system. Provide wall mounting bracket for controller.
2. Remote controller shall have "automatic", "dry" (dehumidification), and "fan only" operating modes.
3. The remote controller shall have the following features:

    a. On/Off power switch.
    b. Mode Selector to operate the system in auto, cool, heat, fan, or dehumidification (dry) operation.
    c. Fan Setting to provide multiple fan speeds.
    d. Swing Louver for adjusting supply louver discharge.
    e. On/Off Timer for automatically switching the unit off or on.
    f. Temperature Adjustment allows for the increase or decrease of the desired temperature.

g. Powerful Operation to allow quick cool down or heating up in the desired space to achieve maximum desired temperature in the shortest allowable time.

4. The remote controller shall perform fault diagnostic functions that may be system related, indoor or outdoor unit related depending on the fault code.
5. Temperature range on the remote controller shall be 64F to 90F in cooling mode and 50F to 86F in heating mode.
6. The indoor unit microprocessor shall have the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote controller.
7. Integration: Manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135. This may be accomplished through a system integration panel or "gateway". Integration panels shall be provided as part of the split system.

H. Outdoor Unit:

1. General:

a. The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be completely factory assembled and pre-wired with all necessary electronic and refrigerant controls.

2. Cabinet:

a. The outdoor unit shall be fabricated of galvanized steel, bonderized and coated with a baked enamel finish for corrosion protection.

3. Fan:

a. The fan shall be direct drive, propeller type fan with fan guard.
b. Fan blades shall be statically and dynamically balanced.
c. The fan shall have permanently lubricated type bearings.
d. Motor shall be protected by internal thermal overload protection.
e. Airflow shall be horizontal discharge.

4. Coil:

a. The outdoor coil shall be nonferrous construction with corrugated fin tube.
b. The coil shall be protected with an internal guard.
c. Refrigerant flow from the condenser shall be controlled via a metering device.

5. Compressor:

a. Hermetic or scroll refrigerant compressors with resilient suspension system, inverter driven, oil strainer, sight glass/moisture indicator, internal motor protection, high pressure switch, and crankcase heater.
b. The outdoor unit shall have an accumulator and four-way reversing valve.

6. Refrigerant:

    a. AHRI rated for direct expansion use with low GWP refrigerants (e.g. R32 or R454B).

I. Integral Condensate Pump:

1. Packaged unit matched to evaporator unit including float switch, pump, motor assembly, check valve, and reservoir.
2. Provide alarm to indicate high level reservoir.
3. Unit shall be powered from evaporator unit with appropriate field connections available.

## 2.2 PIPING

A. Design Pressure: 450 psig; Maximum Design Temperature: 250F

B. Type ACR Seamless Copper Tube Linesets; Brazed Joints:

1. 3/4" and under.
2. Tubing: Type ACR seamless copper tube linesets, ASTM B1003. Sizes indicated are nominal designation.
3. Joints: Brazed with silver solder.
4. Fittings: Wrought copper solder joint, ANSI B16.22.
5. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged, and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.
6. Limitations:

    a. Only between refrigerant splitter box and indoor terminal unit.
    b. For use above ceiling only. Do not use in exposed areas.

C. Type ACR Hard Drawn Seamless Copper Tube; Brazed Joint:

1. 4" and under.
2. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.
3. Joints: Brazed with silver solder.
4. Fittings: Wrought copper solder joint, ANSI B16.22.
5. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

D. Refrigerant linesets are permitted.

1. Provide manufacturer-packaged refrigerant linesets and accessories of sizes needed for installation. Verify lengths of piping required for installation.

2.3 INSULATION

A. EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Minimum 1/2" thick for pipe sizes less than 1-1/4" and 3/4" thick for pipe sizes 1-1/4" and above.

2.4 EXPANSION COMPENSATION

A. Assembly consisting of two flexible connectors, two copper flexible connectors, two 90 elbows, and a 180 return pipe. Unit shall be in the form of a pipe loop.

B. Connectors shall have corrugated copper hose bodies with copper braided casings.

C. Connectors shall be rated for 150 psi working pressure at 70F.

D. Sizes 2" and smaller shall have copper sweat ends.

E. Connectors shall be suitable for 1/2" permanent misalignment.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify that proper power supply is available.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
2. Install units in accordance with manufacturer's instructions. Install all units level and plumb. Indoor units shall be installed using manufacturer's standard mounting hardware securely fastened to building structure.
3. Refer to Section 23 05 29 for concrete base for outdoor unit.
4. Coordinate the exact mounting location of all indoor and outdoor units with architectural and electrical work. Coordinate installation of ceiling-mounted units with ceiling grid layout. Provide additional ceiling grid reinforcement or modification as required and coordinate the work with the GC. Locate the indoor unit where it is readily accessible for maintenance and filter changes. Where outdoor units are located on the roof, locate at least 10' from the roof edge.
5. Verify locations of wall-mounted remote controllers with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Height above finished floor shall not exceed 48".
6. Maintain minimum clearances to all equipment. Maintain manufacturer's minimum maintenance, and airflow clearances, and maintain minimum spaces about electrical equipment, whichever is greater.

a. 120V: 36" deep x 30" wide or the width of the panel whichever is wider.
b. 208V: 42" deep x 30" wide or the width of the panel whichever is wider.
c. 480V: 42" deep x 30" wide or the width of the panel whichever is wider.

B. Condensate Removal:

1. Install condensate piping with trap and route from drain pan to nearest drain. Discharge to nearest code-approved receptor or to a properly vented indirect waste fitting. Flush all piping before making final connections to units.

C. Comb all coils to repair bent fins.

D. Install new filters in the unit at Substantial Completion.

E. A factory-authorized service agent shall assist in commissioning the unit and inspecting the installation prior to startup. Submit startup report with O&M manuals.

## 3.3 REFRIGERANT PIPING

A. Install refrigerant piping from the indoor unit(s) to the condensing unit. Refrigerant pipe sizes, lengths, specialties and configurations shall be as recommended by the manufacturer. Evacuate refrigerant piping and fully charge system with refrigerant per manufacturer's requirements.

B. Provide weather-tight insulated roof curb to accommodate refrigerant piping and conduit roof penetrations.

C. Insulate all refrigerant piping. Both liquid and suction lines shall be insulated between the indoor and outdoor units.

D. Joining of Piping:

1. Brazed Joints:

a. Make up joints with brazing filler metal conforming to ANSI/AWS A5.8. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt, and grease just prior to brazing. Apply flux evenly, but sparingly, to all surfaces to be joined. Brazing filler metal with a flux coating may also be used. Heat joints uniformly to proper brazing temperature so braze filler metal flows to all mated surfaces. Wipe excess braze filler metal, leaving a uniform fillet around cup of fitting.
b. Flux shall conform to ANSI/AWS A5.31.
c. Remove composition discs and all seals during brazing if not suitable for a minimum of 840For greater than the melting temperature of the brazing filler metal, whichever is greater.

E. Insulation:

1. Insulate all refrigerant pipes between the outdoor and indoor units. This includes the liquid pipe, the suction pipe, the hot gas pipe, and the high/low pressure gas pipe. All fittings, valves, and specialty refrigerant components in the piping between the indoor and outdoor units shall also be insulated. The insulation shall have a continuous vapor barrier and shall pass through hangers and supports unbroken. All exterior insulated piping shall be painted with minimum of one (1) coat of UV resistant paint. Over size hangers and supports to allow the insulation to pass through unbroken. Following are the minimum insulation thicknesses unless noted otherwise in the manufacturer's literature or required by local AHJ:

    a. Code/Year: ASHRAE 2013
    b. Refrigerant Suction (40F & Below):

        1) Up to 1": 1/2"
        2) 1" and up: 1"

    c. Refrigerant Suction (41F to 60F):

        1) Up to 1-1/2": 1/2"
        2) 1-1/2" and up: 1"

    d. Refrigerant Liquid:

        1) Up to 1-1/2": 1"
        2) 1-1/2" and up: 1-1/2"

**END OF SECTION 238126**

## SECTION 23 81 45 - VARIABLE REFRIGERANT FLOW HEAT PUMPS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable refrigerant flow split system heat pump (heat/cool).

B. Refrigerant piping/tubing and insulation.

1.2 QUALITY ASSURANCE

A. Manufacturer: Manufacturer shall have a factory trained service contractor within 100 miles of project site.

B. Installed: Company with minimum five years documented experience performing the work of this Section.

C. Installer: Refrigerant system installer shall be certified with one of the following:

1. Commercial Refrigeration Technician Certificate

1.3 REFERENCES

A. ANSI/AHRI 210/240 - Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.

B. ANSI/AHRI 270 - Sound Rating of Outdoor Unitary Equipment.

C. ANSI/ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. MIL-H-22547B - Heat Pump, Heating and Cooling (Unitary).

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00.

B. Indicate water, drain, and electrical rough-in connections on shop drawings or product data.

C. Submit manufacturer's warranty information.

D. Submit installing contractor's manufacturer training certification.

E. Submit refrigerant charge. Charge calculation should be based on installed piping lengths and equipment capacities.

F. VRF Piping Layout Drawings:

1. Submit manufacturer's detailed VRF piping layout drawings at 1/8" = 1'-0" minimum scale complete with the following information at beginning of project:

    a. Actual pipe routing, fittings, hanger and support types, accessories, etc. with lengths and refrigerant charge noted.
    b. Include insulation thickness and type of insulation.
    c. Room names and numbers, ceiling types, and ceiling heights.

2. Submit VRF piping and equipment layout drawings. Verify clearances and interferences with other trades prior to preparing drawings. IMEG will provide electronic copies of piping drawings for Contractor's use if the Contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for this submittal. Submittals shall be in accordance with Section 23 05 00.
3. Following installation and prior to refrigerant charge, Contractor shall verify actual installation, pipe routing, elevation changes, and piping lengths, noting variations from the original manufacturer's design and resubmit to the manufacturer. Manufacturer shall verify layout and determine the final refrigerant charge prior to operation.

G. Submit Electrical Power and Controls Diagrams:

1. Power wiring diagrams for each component.
2. Wiring diagrams and layouts for each control panel showing all termination numbers.
3. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Show all interface wiring to the control system.
4. Schematic diagrams for all field sensors and controllers.
5. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.
6. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Label all terminals.
7. All installation details and any other details required to demonstrate that the system will function properly.
8. All interface requirements with other systems.

H. Sequences: Submit a complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Architect/Engineer. Clearly highlight any deviations from the specified sequences on the submittals.

I. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.

J. Clearly identify work by others in the submittal.

K. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.

L. Manufacturers Startup Report: Submit manufacturers startup report documenting equipment startup. StartUp report shall include Contractor™™s field test reports.

## 1.5 DELIVERY STORAGE AND HANDLING

A. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

## 1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

## 1.7 WARRANTY

A. Installing contractor shall perform tasks required by manufacturer to ensure maximum available warranty is achieved. This will include but is not limited to:

1. System design performed by manufacturer certified designer.
2. System installation performed by manufacturer certified installer.
3. Complete system commissioning paperwork and submit to manufacturer.

B. Provide minimum five (5) year manufacturer's parts warranty (one-year basic warranty plus four-year extended warranty) on all parts (excluding compressors) and one (1) year labor warranty.

C. Provide minimum five (5) year manufacturer's compressor parts warranty.

D. Contractor shall provide one (1) year parts and labor warranty on the associated controls system, including all devices, wiring, and programming.

## 1.8 DEMONSTRATION

A. Engage manufacturer or factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain individual units and complete system.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Daikin AC

B. Carrier/Toshiba

C. Samsung

D. Trane/Mitsubishi

2.2 SYSTEM DESCRIPTION

A. The variable capacity heat pump air conditioning system shall be a variable refrigerant flow split system. The system shall consist of multiple evaporators using PID control and inverter driven heat pump unit. The unit shall consist of direct expansion (DX), air-source heat pump air conditioning system, and variable speed driven compressor multi zone split system.

B. Air-Source Heat Pump Unit - General: The heat pump unit is designed specifically for use with the manufacturer's components:

1. AHRI rated for direct expansion use with low GWP refrigerants(e.g. R32 or R454B).
2. The air-source heat pump unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant control. The refrigeration circuit of the heat pump unit shall consist of a compressor, motors, fans, condenser coil, electronic expansion valves, oil separators, service ports, liquid receivers, and accumulators.
3. All refrigerant lines shall be individually insulated between the heat pump and indoor units.
4. The connection ratio of the nominal capacity of indoor units to heat pump unit shall be 50-130%.
5. The sound pressure shall be no greater than 63 dBA at 4 feet from the heat pump unit at full load at fan height.
6. The system shall automatically restart operation after a power failure and shall not cause any settings to be lost, thus eliminating the need for re-programming.
7. The following safety devices shall be included on the heat pump unit: high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle shall be automatic as required to maintain oil levels at the heat pump unit.
8. The heat pump unit shall be able to operate in heating mode to -4F dry bulb ambient temperature without additional ambient controls.

9. The heat pump unit shall have air cooled heat exchange coils constructed from copper tubing with aluminum fins. The coils shall be capable of being divided into sections to enable the heat pump unit to match the capacity required by the indoor units and to allow individual defrosting to take place as required.
10. The heat pump unit shall have at least one inverter controlled compressor, depending on scheduled capacity. The system shall use a control sequence to ensure that indoor loads are matched to the compressor capacity control.
11. The refrigeration process of the heat pump unit will be maintained by pressure and temperature sensors controlling solenoid valves, check valves, and bypass valves. The heating or cooling mode of the heat pump unit will be controlled using a combination of 2 and 3-way valves that shall reverse the cycle of the refrigerant to change the mode of the heat pump unit.
12. Unit Cabinet: The heat pump unit model shall be completely weatherproof and corrosion resistant. The heat pump unit shall be constructed from steel plate and treated with an anti-corrosive paint.[ Provide hail guards on all condenser coils][ and fans].
13. Fan:

    a. The heat pump unit shall consist of propeller type, direct-drive fan motors that have multiple speed operation via a DC inverter.
    b. The fans shall be a vertical discharge. The fan motors shall have inherent protection and permanently lubricated bearings.
    c. The fans shall be provided with fan guards.

14. Condenser Coil: The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
15. Compressor:

    a. The variable speed compressor shall be capable of changing the speed to follow the variations in total cooling load as determined by the suction gas pressure as measured in the heat pump unit.
    b. The inverter driven compressor in each heat pump unit shall be DC, hermetically sealed, scroll type.
    c. The capacity control range shall be a minimum of 20% to 100% of total capacity.
    d. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
    e. Oil separators shall be standard with the equipment, together with an oil balancing circuit.
    f. The compressor shall be mounted to avoid the transmission of vibration.

16. Bypass Filter Assembly: Provide bypass cartridge filter at outdoor unit. The purpose is to provide refrigerant contaminate filtration for the first 24 hours of operation. Normal operation will bypass filter to outdoor unit.

    a. Replaceable Cartridge Angle Type: ANSI/AHRI 710, UL listed, brass or epoxy-coated steel shell, molded desiccant high-water capacity filter core(s); maximum working pressure of 500 psi; maximum temperature of 275F; maximum pressure drop of 3 psi with design refrigerant at system flow rate.

C. Oil Recovery System:

1. System shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping.
2. System shall be designed for proper oil return to compressor, along with distribution of oil to individual compressor.

D. Indoor Units:

1. Each indoor unit shall have a heat exchanger that shall be constructed from copper tubing with aluminum fins. The flow of refrigerant through the heat exchanger shall be controlled by an electronic modulating expansion valve. This valve shall be controlled by internal temperature sensors and shall be capable of controlling the variable capacity of the indoor unit between at least 25% and 100%. The units shall be shipped from the factory fully charged with dehydrated air.
2. The indoor units shall be designed for installation within a conditioned space to be connected to an air-source heat pump air conditioning system.
3. Wall Mounted:

    a. Acoustic Performance: The indoor units' sound pressure shall not exceed 35 dBA at low speed measured at 3.3 feet from the units.
    b. Construction:

        1) The indoor units shall be completely factory assembled and tested. Included in each unit is factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. Each unit shall have at least one auto-swing louver for efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge louver angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The condensate drain pipe shall be able to be connected to either left or right sides.

    c. The indoor units shall be equipped with a return air thermistor.
    d. The indoor unit shall be separately powered.
    e. Unit Cabinet:

        1) The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
        2) The cabinet shall be constructed of molded plastic cover with sound absorbing foamed polystyrene and polyethylene insulation.

    f. Fan:

        1) The fan shall be a direct-drive cross-flow type, statically and dynamically balanced with high and low fan speeds available.
        2) The fan motor shall be thermally protected.

g. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
h. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2) The refrigerant connections shall be flare connections and the condensate shall be coordinated with piping material specified in Section 23 21 00.
3) A condensate pump with at least 18 inches lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.
4) A thermistor shall be located on the liquid and gas line.

4. Four-way Ceiling-Recessed Cassette:

a. The indoor unit shall be a ceiling cassette for installation into the ceiling cavity, equipped with an air panel grille as scheduled and specified in this section. The indoor unit shall have four-way air distribution and an ivory white, impact resistant, washable decoration panel. The supply air shall be distributed via motorized louvers that can be horizontally and vertically adjusted from 0-degree to 90-degree angle.
b. Acoustic Performance: The indoor units' sound pressure shall not exceed 33 dBA at low speed measured at 5 feet from the unit.
c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2) The 4-way supply airflow shall be field modifiable to 3-way and 2-way airflow to accommodate various installation configurations, including corner installations.
3) Return air shall be through the concentric panel, which shall include a filter.
4) The indoor units shall be equipped with a return air thermistor.
5) The indoor unit shall be separately powered.

d. Unit Cabinet:

1) The cabinet shall be space saving and shall be recessed into the ceiling.
2) Provide fresh air intake kit where used and indicated on the drawings. A branch duct knockout shall exist for branch ducting supply air.
3) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds available.
2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by a washable long-life filter with mildew proof resin.
g. Coil:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2) The refrigerant connections shall be flare connections and the condensate shall be coordinated with piping material specified in Section 23 21 00.
3) A condensate pump with at least 18 inches lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.
4) A thermistor shall be located on the liquid and gas line.

## 2.3 PIPING

A. Design Pressure: 450 psig.

1. Maximum Design Temperature: 250F.

B. Type ACR Seamless Copper Tube Linesets; Brazed Joints:

1. 1" and under.
2. Tubing: Type ACR seamless copper tube linesets, ASTM B1003. Sizes indicated are nominal designation.
3. Joints: Brazed with silver solder.
4. Fittings: Wrought copper solder joint, ANSI B16.22.
5. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged, and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.
6. Limitations:

a. Only sizes 1" and under.
b. For use above ceiling only. Do not use in exposed areas.

C. Type ACR Hard Drawn Seamless Copper Tube; Brazed Joint:

1. 4" and under.
2. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.
3. Joints: Brazed with silver solder.
4. Fittings: Wrought copper solder joint, ANSI B16.22.

5. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

## 2.4 CONTROLS GENERAL

A. The unit shall have controls provided with the unit by the manufacturer to perform input functions necessary to operate the system.

B. Computerized PID control shall be used to maintain room temperature within 1F of setpoint.

C. The unit shall be equipped with a programmable drying cycle that dehumidifies while inhibiting changes in room temperature.

D. The indoor circuit board shall be wired to enable auxiliary heating when at least one of the following occurs:

1. Coil thermistor temperature drops below a factory setpoint in heating mode.
2. Heat pump temperature drops below setpoint (adj.).
3. Based on a user adjustable schedule.

## 2.5 CENTRAL CONTROLLER - TYPE D

A. This controller shall be wall mounted and hard wired, either directly to the control system or via gateway. It shall be manufactured in ABS plastic with an LCD display and shall be the manufacturer's standard color. The controller shall be capable of individually controlling the following functions on at least 128 indoor units:

1. On/off
2. Operating mode
3. Setpoint
4. Fan speed
5. Louver position
6. Timer settings
7. Test run

B. The controller shall also be capable of displaying the following information individually for at least 128 indoor units:

1. On/off
2. Operating mode
3. Setpoint
4. Fan speed
5. Louver position
6. Timer settings
7. Test run
8. Fault diagnosis

C. Each central controller unit can be accessed either locally or remotely via standard internet software. The central controller will be able to indicate system alarms via volt free contacts, as well as providing control points for other devices. Additionally, the central controller shall be able to monitor individual usage of heating and cooling demands, report alarm and conditions to nominated email address, and enable remote alteration of systems setpoints to registered users. All required software costs and licensing fees shall be included for the life of the systems.

D. MAINTENANCE ACCESS

E. Provide all gateways and connection cabling for performing maintenance functions on system.

F. Provide all software and registration codes as required to allow access into advanced maintenance functions.

2.6 SEQUENCE

A. Install a remote mounted temperature sensor.

B. The thermostat shall stage heating or cooling as required to maintain space setpoint at 74F (adj.).

C. Thermostat shall automatically change the indoor unit mode based on the space setpoint.

D. Central controller shall enable dedicated heat pump unit based on an adjustable occupancy schedule. Coordinate enable/disable function with AHU manufacturer.

2.7 SYSTEM INTEGRATION

A. Integration: Manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135. This may be accomplished through a system integration panel or "gateway". Integration panels shall be provided as part of the VRF system.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

B. Install in accordance with manufacturer's instructions. Install all piping, fittings, and insulation to meet manufacturer's requirements. Install units level and plumb. Evaporator fan components shall be installed using manufacturer's standard mounting devices securely fastened to building structure. Install and connect refrigerant tubing and fittings.

C. Installing contractor shall attend manufacturer sponsored training to obtain installation certification. Submit training certificates as noted in Part 1.

D. Installer shall supply isolation ball valves for zoned refrigerant isolation. Installer shall supply isolation ball valves with Schrader connection for isolating refrigerant charge and evacuation at each connected indoor unit and heat pump unit. Isolation ball valves, with Schrader connection, are required for instances of indoor unit isolation for troubleshooting, repair, or replacement without affecting the remainder of the system. Isolation ball valves with Schrader connection are also required at heat pump unit connection to isolate unit for troubleshooting, repair, or replacement and as required to provide partial capacity heating/cooling in the instance of a failure of one of the multiple heat pump unit compressors.

E. Insulate all refrigerant pipes between the heat pump and indoor units. This includes the liquid pipe, the suction pipe, the hot gas pipe, and the high/low pressure gas pipe. All fittings, valves, and specialty refrigerant components in the piping between the indoor and heat pump units shall also be insulated. The insulation shall have a continuous vapor barrier and shall pass through hangers and supports unbroken. All exterior insulated piping shall be painted with minimum of one (1) coat of UV resistant paint. Over size hangers and supports to allow the insulation to pass through unbroken. Following are the minimum insulation thicknesses unless noted otherwise in the manufacturer's literature or required by local AHJ:

1. ASHRAE 2013:
2. IECC 2018:

    a. Refrigerant Suction (40F & Below):

        1) Up to 1": 1/2"
        2) 1" and up: 1"

    b. Refrigerant Suction (41F to 60F):

        1) Up to 1-1/2": 1/2"
        2) 1-1/2" and up: 1"

    c. Refrigerant Low Pressure Gas (141F to 200F):

        1) Up to 1-1/2": 1-1/2"
        2) 1-1/2" and up: 2"

    d. Refrigerant High Pressure Gas (201F to 250F):

        1) Up to 4": 2-1/2"

    e. Refrigerant Liquid:

        1) Up to 1-1/2": 1"
        2) 1-1/2" and up: 1-1/2"

F. Engage manufacturer or factory-authorized service representative to perform startup service. Manufacturer shall provide on-site startup and commissioning assistance through job completion. Complete installation and startup checks according to manufacturer's written instructions.

G. Fully charge system with refrigerant based on volume per manufacturer's requirements using actual field dimensions (not original design submittal). Installing Contractor must coordinate final pipe sizes and lengths, and equipment location, with manufacturer to determine exact fill volume.

H. Field Quality Control:

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing.
2. Perform the following field tests and inspections, and prepare test reports:

    a. Positive Pressure Leak Test: After installation, test for leaks by charging the system per manufacturer’s airtight positive test criteria for a minimum of 24 hours. Repair leaks and retest until no leaks exist.
    b. Negative Pressure Leak Test: After positive pressure leak test, evacuate the system with a vacuum pump per manufacturer’s vacuum drying test criteria. The system shall maintain vacuum without pump operation or gauge movement for a minimum of 1 hour. If the gauge rises, the system may contain moisture or have leaks. Repair leaks and retest until no leaks exist. Manufacturer shall be present to witness the negative pressure test.
    c. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    e. Provide field test reports to manufacturer to include with manufacturer’s startup report.

I. Coordinate installation of units with architectural and electrical work. Coordinate installation of ceiling recessed units with ceiling grid layout. Additional ceiling grid reinforcement or modification is the responsibility of the Mechanical Contractor and shall be coordinated with the General Contractor.

J. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Height above finished floor shall not exceed 48".

K. Contractor is responsible for routing all condensate drains from all indoor equipment to a nearby floor drain or standpipe. If ceiling heights or space finish does not accommodate gravity drainage, Contractor is responsible for providing a condensate pump and all electrical work required.

L. Contractor is responsible for installing VRF heat pump control system. Contractor shall coordinate with the Temperature Controls Contractor to determine extent of integration with building automation system (BAS). Equipment that is required to integrate the VRF heat pump system with the BAS is the responsibility of the VRF heat pump installing contractor. Final connections between VRF heat pump system and BAS shall be by the Temperature Controls Contractor.

M. Maintain minimum clearances to all equipment. Maintain manufacturer's minimum maintenance, and airflow clearances and maintain minimum spaces about electrical equipment, whichever is greater.

1. 120V: 36" deep x 30" wide or the width of the panel whichever is wider.
2. 208V: 42" deep x 30" wide or the width of the panel whichever is wider.
3. 480V: 42" deep x 30" wide or the width of the panel whichever is wider.

## 3.2 JOINING OF PIPE

A. Brazed Joints:

1. Make up joints with brazing filler metal conforming to ANSI/AWS A5.8. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to brazing. Apply flux evenly, but sparingly, to all surfaces to be joined. Brazing filler metal with a flux coating may also be used. Heat joints uniformly to proper brazing temperature so braze filler metal flows to all mated surfaces. Wipe excess braze filler metal, leaving a uniform fillet around cup of fitting.
2. Flux shall conform to ANSI/AWS A5.31.
3. Remove composition discs and all seals during brazing if not suitable for a minimum of 840F (or greater than the melting temperature of the brazing filler metal, whichever is greater).

## 3.3 REFRIGERANT PIPING SUPPORTS AND ANCHORS

A. Horizontal Supports: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Type ACR Hard Drawn Seamless Copper Tube (Liquid Service):

a. Maximum Spacing:

1) 3/4" and under: 5'-0"
2) 1": 6'-0"
3) 1-1/4": 6'-0"
4) 1-1/2" 6'-0"
5) 2": 8'-0"

2. Type ACR Hard Drawn Seamless Copper Tube (Vapor Service):

a. Maximum Spacing:

1) 3/4" & under: 6'-0"
2) 1": 6'-0"
3) 1-1/4": 6'-0"
4) 1-1/2": 6'-0"
5) 2": 8'-0"

3. ACR Seamless Copper Tube Linesets:

a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 10 feet.

C. Install piping support within 2 feet of equipment connections.

**END OF SECTION 238145**

## SECTION 23 82 00 - TERMINAL HEAT TRANSFER UNITS

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fan Coil Units.

1.2 QUALITY ASSURANCE

A. All electrical equipment shall have a UL label.

1.3 REFERENCES

A. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.6 REGULATORY REQUIREMENTS

A. Conform to ASHRAE 90.1.

## PART 2 - PRODUCTS

2.1 FAN COIL UNITS

A. Units shall include cabinet, fan, motor, coils, filter and discharge grille.

B. Exposed cabinets shall be minimum 18 gauge steel with baked enamel finish, color selected by the Architect and no plastic exposed parts. Cabinet shall be insulated with 1/2" thick closed cell elastomeric foam insulation with maximum K value of 0.25 at 75F, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723

C. Fans: Centrifugal forward-curved, double-width with galvanized steel scrolls. Fans shall be statically and dynamically balanced to reduce noise levels.

D. Motor: Fan motor voltage shall be as scheduled on the drawings. Motors shall be permanently lubricated, direct drive.

1. Electronically commutated motor (ECM).

E. Coils shall have copper headers and tubes and aluminum fins.

F. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.

G. Overflow Protection: Provide water-level detection device conforming to UL508 in the primary drain pan that shuts down the equipment on all units.

H. Provide condensate piping and tie into drainage system.

I. Filters: 1" woven glass fiber disposable type.

J. Disconnect: Provide unit-mounted disconnect switch.

K. Speed Control: Provide unit mounted fan speed control.

L. Provide oversized left and right end piping compartments.

M. Provide with tamperproof cabinet front.

N. Coil Connections: Units shall have separate coils for heating and cooling (4-pipe).

O. Manufacturers:

1. Air-Therm
2. Trane
3. Daikin
4. Enviro-Tech/JCI
5. Nailor

## PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

B. Install all products per manufacturers' instructions.

1. Coordinate recess sizes for recessed equipment.
2. Protect units with protective covers during construction.
3. Comb all coils to repair bent fins.

3.2 CLEANING

A. After construction is complete, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by manufacturer.

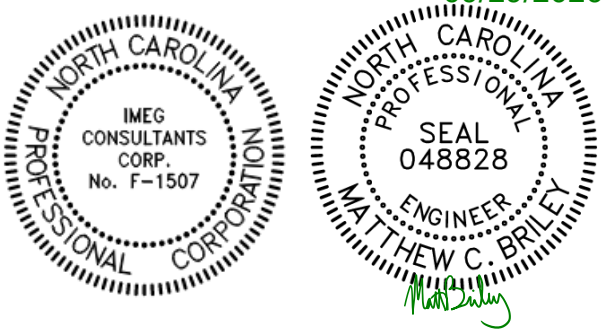
C. Install new filters.

**END OF SECTION 238200**

ELECTRICAL SPECIFICATIONS


| | |
|---|---|
| 260000 | GENERAL PROVISIONS (ELECTRICAL) CONTRACT |
| 260520 | WIRES AND CABLES |
| 260533 | BOXES AND CABINETS |
| 260545 | CONDUIT AND CONDUIT FITTINGS |
| 260800 | ELECTRICAL COMMISSIONING REQUIREMENTS |
| 262213 | DRY TYPE TRANSFORMERS |
| 262416 | PANEL BOARDS AND CIRCUIT BREAKERS |
| 262726 | WIRING DEVICES |
| 262727 | DISCONNECTS |
| 263213 | STANDBY POWER GENERATOR |
| 263214 | 3-WAY MANUAL TRANSFER SWITCH |
| 263353 | STATIC UNINTERRUPTIBLE POWER SUPPLY |
| 263623 | AUTOMATIC TRANSFER SWITCH |
| 265100 | LIGHTING FIXTURES |
| 270000 | TELECOMMUNICATION DISTRIBUTION SYSTEM |
| 283100 | ADDRESSABLE FIRE ALARM SYSTEM |
| 285000 | BI-DIRECTIONAL ANTENNNA SYSTEM (BDA) |
| 285500 | RF SURVEY FOR EMERGENCY RESPONDER RADIO ANTENNA/REPEATER SYSTEM |


09/29/2026



SECTION 260000 - GENERAL PROVISIONS ELECTRICAL

PART 1 - GENERAL

1.1 Scope of Work

A. This Contractor shall provide all materials, equipment and labor necessary to install and set into operation the electrical equipment as shown on the Engineering Drawings and as contained herein.

1.2 Quality Assurance

A. See the General and Supplementary General Conditions.

B. All work shall be in accordance with the North Carolina State Building Code, which includes the 2020 edition of the National Electrical Code.

C. Wherever the words "Approved", "Approval", and "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.

D. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.

E. All material and equipment that the Contractor proposes to substitute in lieu of those specified shall be submitted to the Engineer ten (10) days prior to the bid date for evaluation. The submittal shall include a full description of the material or equipment and all pertinent engineering data required to substantiate the equality of the proposed item to that specified.

1.3 Submittals

A. See General and Supplementary General Conditions and Division 1.

B. Within ten (10) days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit for approval to the Architect/Engineer a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time. Six (6) sets of submittal data shall be provided for approval.

C. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitution for specified items. Acceptance for approval shall be in writing from the Engineer.

D. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent on receipt of these as-built plans.

E. The Contractor shall furnish an electronic set of maintenance and operating instructions, parts lists, electrical circuit wiring diagrams, all submittal data, and sufficient manufacturer's literature to operate and maintain all equipment.

F. The Contractor shall submit to the Engineer a duplicate set of final electrical inspection certificates prior to final payment.

1.4 Product Delivery, Storage and Handling

A. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.

B. The Contractor shall protect all material and equipment from breakage, theft or weather damage. No material or equipment shall be stored on the ground.

C. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.

1.5 Work conditions and Coordination

A. The Contractor shall review the mechanical plans to establish points of connection and the extent of electrical work to be provided in his Contract.

B. This Contractor shall be responsible for all electrical work and make final connections to equipment installed in his Contract. Unless otherwise noted, this Contractor shall wire to disconnect switches, junction boxes, or circuit breakers as provided in his Contract.

C. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be approved by Architect/Engineer and shall be at the Contractor’s expense with no extra cost to the owner.

1.6 Guarantee

A. See the General and Supplementary General Conditions.

B. Where extended warranties or guarantees are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Owner.

PART 2 - PRODUCT

2.1 Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Materials and equipment found defective shall be removed and replaced at the Contractor's expense.

2.2 All materials and equipment be approved third party labeled or bear re-examination listing where such approval has been established for the type of device in question.

PART 3 - EXECUTION

3.1 Inspection

A. If any part of this Contractor's work is dependent for its proper execution or for its subsequent efficiency or appearance on the character or conditions of contiguous work not executed by him, the Contractor shall examine and measure such contiguous work and report to the Architect or Engineer in writing any imperfection therein, or conditions that render it unsuitable for the reception of this work. Should the Contractor proceed without making such written report, he shall be held to have accepted such work and the existing conditions and he shall be responsible for any defects in this work consequent thereon and will not be relieved of the obligation of any guarantee because of any such imperfection or condition.

B. It is the responsibility of the electrical contractor to notify the authority having jurisdiction to schedule required inspections including rough-in, above ceiling and final inspections.

3.2 Installation

A. All work shall be performed in a manner indicating proficiency in the trade.

B. All conduit, pipes, ducts, etc., shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.

C. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.

D. All patching shall be done in such a manner as to restore the areas or surfaces as to match existing finishes.

E. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish and install all sleeves or openings through poured masonry floors or walls above grade required for passage of all conduits, pipes or duct installed by him. The Contractor shall furnish and install all inserts and hangers required to support his equipment.

F. Grounding

1. All grounding shall be in accordance with the requirements of the NEC.

2. Install a separate green grounding conductor with the circuit conductors in each conduit. Use of the conduit only shall not be an acceptable means of equipment grounding.

3. All grounding conductors shall be sized per Article 250.122 of the NEC.

4. The ground system shall be tested with an "Earth Megger" and the test report submitted to the Engineer. If resistance exceeds 25 ohms provide an additional driven ground rods separated by a minimum of 6' interconnected with #3/0 copper. A copy of the test report shall be submitted to the electrical engineer.

5. All ground points shall be accessible for inspection.

6. Boxes with concentric, eccentric or over-sized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC Table 250.122 and lugged to the box.

G. Electrical Identification

1. Furnish and install engraved laminated phenolic nameplates for all safety switches, panel boards, transformers, switchboards, motor control centers and other electrical equipment supplied for the project for identification. Nameplates shall be securely attached to equipment with self-tapping stainless-steel screws; if the screw sharp end is protected; otherwise Rivets shall be used. Letters shall be approximately 1/2-inch-high minimum. Embossed, self-adhesive plastic tape is not acceptable for marking equipment. Nameplate material colors shall be:

   a. Blue surface with white core for 120/208-volt equipment.

   b. Black surface with white core for 277/480-volt equipment.

   c. Bright red surface with white core for all equipment related to fire alarm system.

   d. Dark red (burgundy) surface with white core for all equipment related to security.

   e. Green surface with white core for all equipment related to “emergency” systems.

   f. Orange surface with white core for all equipment related to telephone systems.

   g. Brown surface with white core for all equipment related to data systems.

   h. White surface with black core for all equipment related to paging systems.

   i. Purple surface with white core for all equipment related to TV systems.

2. Furnish and install self-adhesive plastic tape for all receptacle and wall switch cover plates indicating circuit numbers.

3. Furnish and install self-adhesive embossed plastic labels on outside of all junction box cover plates indicating circuit numbers.

4. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.

3.3 Performance

A. The Contractor shall perform all excavation, backfilling, and patching operations as indicated on the drawings.

3.4 Erection

A. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.

3.5 Field Quality Control

A. The Contractor shall conform to the requirements of Division 3 for concrete testing.

B. The Contractor shall test his entire installation and shall furnish the labor and materials required for these tests. Tests shall be performed in accordance with the requirements of the section of the specifications and in accordance with the requirements of the State Ordinances and Codes, and the National Electrical Code. The Contractor shall notify the Engineer of his readiness for such test. Final inspections are required along with final inspection certificates are required, prior to authorization of final payment.

C. Testing required for compliance with the Contract shall be stated in subsequent sections. All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information. All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the prerequisites for, final acceptance of the project.

D. Documentation

1. All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.

2. All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the prerequisites for, final acceptance of the project.

3.6 Adjust and Clean

A. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.

B. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for the intended service. In no event shall nameplates be painted.

C. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract (in the presence of the Engineer).

END OF SECTION 260000

THIS PAGE IS INTENTIONALLY LEFT BLANK

SECTION 260520 - WIRES AND CABLES

PART 1 - GENERAL

1.1 All conductors shall be properly marked showing manufacturer's name, insulation type, voltage rating and wire size. All insulation is to be rated for minimum of 600 volts.

1.2 Wire sizes shall be as shown. No wire smaller than No. 12 AWG shall be used. The maximum conductor size shall be 500 KCMIL.

1.3 Where the conductor length from the panel to the first outlet on a 120 volt exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall be increased by at least one size. Refer to the wire size chart on the drawings. Per NEC 250.122(B), equipment grounding conductors, where installed shall be increased in size proportionately according to the circular mil area of the ungrounded conductors.

1.4 Conductors shall be manufactured by US Wire and Cable, Triangle, Okonite, Southwire, or approved equivalent.

1.5 Wiring for 120/208-volt systems and 277/480-volt systems shall not be mixed in the same race way, pull or junction box.

PART 2 - PRODUCT

2.1 All conductors shall be copper and shall conform to Underwriters' Standards. Wires No. 10 and smaller shall be solid. Wires 8 and larger shall be stranded.

2.2 All wire shall be labeled two (2) feet on centers giving size, type voltage, rating, and manufacturer's name. Wire #6 and smaller #6 shall be factory color coded. Wire larger than #6 may be color coded with approved 2000-volt colored tape at all terminals of the run, and at all junctions.

2.3 Where applicable, all wire shall be color coded as follows, or approved by the Engineer:

A. 120/208-volt system:

| | |
|---|---|
| Phase A | Black |
| Phase B | Red |
| Phase C | Blue |
| Neutral | White |
| Ground | Green |

B. 277/480-volt system:

| | |
|---|---|
| Phase A | Brown |

| | |
|---|---|
| Phase B | Orange |
| Phase C | Yellow |
| Neutral | Natural Gray |
| Ground | Green |

2.4 Insulation type shall be UL labeled for the appropriate type of use and temperature. Insulation types are as follows:

A. The insulation type for interior wiring shall be dual-rated THHN/THWN or XHHW.

B. The insulation type for wiring in exterior wet locations shall be THWN-2 or XHHW-2.

PART 3 - EXECUTION

3.1 Conductors shall be run in conduit and shall be continuous from outlet to outlet. Splices will not be made except within accessible outlet or junction boxes, troughs, or gutters.

3.2 Metal-Clad Cable: Type MC

A. MC Cable is allowed in this project. See general notes on plan for restrictions.

B. Installation shall be NEC restriction.

3.3 Solid conductors shall be spliced by using Ideal "wing- nuts", 3M Company's "Scotchlok" connectors for branch circuit splices. Crimp connectors will not be allowed for branch circuit splicing.

3.4 Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with U/L-approved insulating covers, may be used instead of mechanical connectors plus tape.

3.5 On mechanical splices, taps or joints taping shall be with at least two (2) layers of approved gum rubber tape which will be laid on the half-lap followed by at least one (1) layer of friction or plastic tape laid on with half-lap. It is intended that all taping shall be a permanently secured insulation equal to that of the wire.

3.6 All conductors in any conduit shall be at one specific voltage. Conductors of different voltages shall be run in separate conduits.

3.7 Neutral conductors shall be properly installed as to prevent grounding of the neutrals in any conduit. Multi-wire circuits with shared neutral conductors are not allowed. Each single pole load shall have individual neutral for each circuit.

3.8 Neatly train and lace wiring inside boxes, equipment, and panelboards.

3.9 Make conductor lengths for parallel circuits equal.

3.10 Pull all conductors into a raceway at the same time. Use third party approved wire pulling lubricant for pulling #4 AWG and larger wires.

3.11 Insulation Resistance Testing.

All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500-volt megger. The procedures listed below shall be followed:

A. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between conductors and between conductor and the grounding conductor.

B. After all fixtures, devices and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall then test each one separately to the panel and until the low readings are found. The contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

C. The contractor shall send a letter to the engineer certifying that the above has been done and tabulating the megger readings for each panel. This shall be done at least four (4) days prior to the final inspection.

3.12 Use of split bolt connectors is not acceptable.

3.13 Prior to energizing, feeders and service conductor cables shall be tested for electrical continuity and short circuits. A copy of these tests should be sent to the engineer of record and the owner.

END OF SECTION 260520

THIS PAGE IS INTENTIONALLY LEFT BLANK

**SECTION 260533 BOXES AND CABINETS**

PART 1 - GENERAL

1.1 The Electrical Contractor shall provide junction boxes, pull boxes, cable, support boxes, and wiring troughs as required by NEC and as otherwise indicated in the Drawings.

1.2 All necessary mounting hardware and accessories shall be provided for a complete installation.

PART 2 - PRODUCT

2.1 Outlet and junction boxes shall be 4" minimum size, octagonal in ceilings, 4" square or rectangular (4" x 4" minimum for walls) except as noted below. Ceiling outlet boxes shall not be less than 1 1/2" deep, but in no case shall the size and depth of boxes be less than the required by the NEC.

2.2 Outlet boxes shall be equipped with plaster rings of appropriate depth to finish flush with finished walls. Outlets in exposed masonry wall shall be equipped with extra deep square corner tile rings so that box may be installed in the core of the block.

2.3 Outlets for concealed work and ceiling outlets for exposed work shall be galvanized stamped steel. Boxes shall be as manufactured by ABB-Steel City, Hubbell-RACO, Appleton or equivalent.

2.4 Wall outlets for exposed conduit work shall be Crouse-Hinds, Appleton, Hubbell-Killark or equal, series FS and FD switch and receptacle threaded hub boxes, with matching FS and FD covers.

2.5 Junction boxes for change of direction or feeder taps shall be furnished where required, shall be of adequate size to prevent crowding conductors in accordance with the requirements of the electrical code and job requirements and shall be accessible.

2.6 Junction boxes on finished wall and ceilings shall be flush with covers.

2.7 Junction boxes larger than 5" square shall be galvanized and without pre-formed knockouts.

PART 3 - EXECUTION

3.1 Boxes and troughs shall be supported independently of conduit entering them. Brackets, threaded rod hangers with lock nuts, bolts, or other suitable supporting methods may be used.

3.2 Thru-the-wall outlet boxes shall not be permitted. Outlet boxes shown back to back on plans, shall be separate boxes connected where required using a loop of flexible metallic conduit with ground wire. Boxes shall be separated a minimum of 18 inches apart.

3.3 In general, outlets shall be installed at the heights indicated on the fixture and symbol legend.

3.4 Each outlet designated on the plans shall be provided with an outlet box.

3.5 Each outlet box which supports a fixture shall be provided with a fixture stud into the outlet box. Outlet box and/or fixture stud shall be attached with not less than three screws or bolts.

3.6 Exterior outlets shall be provided with watertight gaskets. Outlet covers are to be weatherproof while in use and extra-duty rated.

END OF SECTION 260533

THIS PAGE IS INTENTIONALLY LEFT BLANK

## SECTION 260545 - CONDUIT AND CONDUIT FITTINGS

PART 1 - GENERAL

1.1 Conduit shall be delivered to the project site in bundles of full-length pipes, each length marked with the trademark of the manufacturer and the Underwriters' Laboratories, Inc. stamp. Each conduit length shall be straight, true and free from scales, blisters, burrs and other imperfections.

1.2 Within the building parameters and above the floor slab, the rigid steel conduit specified shall be used unless specifically noted otherwise.

1.3 Conduit size for control wiring shall be a minimum of one-half (1/2) inch conduit. All branch circuit conduit shall be a minimum of one-half (1/2) inch. Percent filled and derating shall be in accordance with the National Electrical Code. Flexible metal and water-tite ("sealtite") conduit in size 1/2" and larger shall be acceptable for motor, appliance, and fixture connections from fixture junction boxes or appliance/motor disconnects provided a ground wire is installed in the flex and the flex assembly is an integral part of the fixture, shipped from the same factory as the fixture, and 3rd party agency approved for such use. This same requirement shall apply for motor/appliance connections.

1.4 All conduit shall be installed in accordance with the National Electrical Code.

1.5 Metallic conduits shall be manufactured by Allied, Wheatland, Cruse-Hinds, or equivalents.

1.6 Non-metallic conduits shall be manufactured by Prime Conduit, Cantex, Champion Fiberglass or equivalents.

1.7 Conduit fittings shall be manufactured by Rayco, T & B, Crouse Hinds, O-Z/Gedney or equivalents.

1.8 Surface mounted raceway shall be used as noted on the plans in lieu of exposed conduit. Surface mounted raceway shall be manufactured by Wiremold or approved equivalents.

PART 2 - PRODUCT

2.1 Thin Wall Conduit and Fittings

A. Electrical metallic tubing (EMT) shall be cold-rolled steel tubing with zinc coating on the outside and protected on the inside by a zinc, enamel or equivalent corrosion-resistant coating conforming to the latest requirements of ANSI. Conduit shall meet the Rigid Conduit Association Standards.

B. Electrical metallic tubing fittings shall be all steel plated hexagonal threaded compression type. No pot metal, indenter, or set screw fittings, shall be used. EMT connectors shall have insulated throats.

2.2 Rigid Steel Conduit and Fittings

A. Rigid steel conduit, including elbows and nipples, shall be standard weight, mild steel pipe, hot dipped galvanized, sherardized or zinc-coated conforming to the requirements of ANSI

C80.1, 1966 or later edition. Rigid steel conduit shall also meet the latest requirements of Underwriters' Laboratories, Inc. Standards for Rigid Metallic Conduit.

B. Fittings shall be all steel plated hexagonal threaded fitting.

2.3 Flexible Metal Conduit and Fittings

A. Flexible metal conduit shall be of the best grade interlocking spiral strip steel. The interlocking spiral strip construction shall be such as to permit bending of the conduit to a radius of four (4) times its internal diameter without distorting at any point. The interior and the exterior of the flexible conduit shall be smooth and free of burrs, sharp edges, or other defects which could damage the wire.

B. Fittings shall be of the approved types, made of malleable iron and hot dipped galvanized.

C. All connectors shall be steel compression fittings with insulated throats.

D. Where watertight flexible conduit is required, it shall have an outer sheath of material similar to PVC.

2.4 Non-metallic Conduit

A. Non-metallic conduit shall be UL listed, for its application. It shall be resistant to sunlight and chemical and moisture atmospheres and rated for use with 90 degrees Celsius conductors.

B. The installation and usage of rigid non-metallic conduit shall comply with Article 352 of the National Electrical Code, along with any related or referenced sections.

PART 3 - EXECUTION

3.1 General

A. All conduit shall be run tight against walls, columns or ceilings.

B. The conduit shall bend cold 90 degrees about a radius equal to ten (10) times its own diameter without signs of flaw or fracture in either pipe or protective coverings. All bends and offsets shall be made on a forming tool to prevent the conduit or its coating from being damaged in the bending. Conduit bends shall have a radius not less than ten (10) times the conduit diameter.

C. Where conduits join any couplings or threaded fittings, the ends shall be made watertight. (All conduit runs, including boxes, couplings, and fittings used therein, shall be so installed and equipped as to prevent water from entering the conduit.)

D. All conduits shall be carefully cleaned before and after erection. After cleaning, all ends of conduits shall be free from burrs and inside surfaces shall be free from imperfections likely to injure the wires or cables.

E. In every instance, conduit shall be installed in such a manner that the conductors may readily and easily be drawn or pulled in without strain or damage to the insulation; and, also, so that defective conductors may be readily and easily withdrawn and replaced by new conductors. Long radius bends and a sufficient number of approved pull and junction boxes shall be

approved for this purpose, and as may be directed by the Engineer. All conduit shall be securely supported and grounded.

F. In unfinished areas, exposed conduit shall be run to conform to the building lines with special emphasis on neatness. Turns shall be made with galvanized outlet boxes, junction boxes, factory fittings and/or symmetrical bends. Locknuts and bushings shall be employed to provide full grounding and adequate protection of insulation. Double locknuts shall be used on all conduits entering sheet metal enclosures.

G. Support for all conduit shall be in accordance with the National Electrical Code. Conduit shall be supported by approved pipe straps or clamps, secured by means of toggle bolts on hollow masonry, expansion shields and matching screws or standard pre-set inserts on concrete or solid masonry, machine screws or bolts on metal surfaces, and wood screws on wood construction.

H. All empty conduit systems shall be capped or terminated in a junction box and shall be provided with nylon pull cord inside for future use.

I. Conduit terminating below grade shall be provided with means to prevent entry of dirt or moisture. Depth of burial shall not be less than two (2) feet below grade. All termination points shall be accurately marked and dimensioned on the As-Built Plans.

J. Where conduits of any type pass over a building expansion joint, a standard "expansion joint fitting" compatible with the type of raceway shall be provided.

K. Conduits installed on the interior of exterior building walls shall be spaced off the surface a minimum of 1/4” using “clamp-backs” or strut.

3.2 Thin Wall Conduit and Fittings

A. Except for service and feeder conduits, electrical metallic tubing and fittings may be installed in lieu of rigid conduit in dry construction in furred spaces, ceiling cavities, chase spaces, interior portions other than concrete and solid plaster, or for exposed work except on mechanical structure or supports.

B. Electrical metallic tubing shall not be installed.

1. Where exposed to severe corrosive conditions and/or severe physical damage,

2. Nearer than four (4) feet from finished floor in exposed areas

3. In trade sizes larger than two (2) inches

4. Located in exterior walls or in poured concrete.

5. Any location outdoors.

6. Where tubing, coupling, elbows and fittings would be in direct contact with the earth or underground (in/below slab-on-grade or in earth.

C. A transition between a run of rigid conduit concealed in a wall and a run of thin wall conduit along a ceiling shall be made in an outlet box above the ceiling, if accessible, near the wall.

3.3 Rigid Steel Conduit and Fittings

A. All conduit terminations shall be provided with insulating bushings.

B. Conduit fittings shall not be used in lieu of pull boxes.

C. Except where located under the ground floor slab, all service and feeder conduit shall be heavy wall (rigid galvanized).

D. Rigid steel conduit shall be installed in exterior masonry walls, in wet locations where subject to severe physical damage, or where conduit trade size is two and one half (2 1/2) inches or larger.

3.4 Flexible Metal Conduit and Fittings

A. Flexible metallic conduit shall be provided at the end of each conduit run terminating at the conduit box on electric motors, transformers or other equipment.

B. The length of flexible conduit shall be in accordance with the National Electric Code.

3.5 Non-Metallic Conduit

A. Thin wall rigid non-metallic conduit (schedule 40 PVC) shall only be used for concrete encasement.

B. Except where embedded in concrete, conduit shall be supported to permit adequate lineal movement to allow for expansion and contraction of conduit due to temperature change. Where a temperature change in excess of 14 degrees Celsius is anticipated, such as direct burial, exposed outside of the building, or in un-insulated spaces inside the building (attics, crawl spaces, etc.), expansion joints shall be installed in accordance with the manufacturer's specifications.

C. Heavy wall non-metallic conduit (schedule 80 PVC) shall be used where conduits are direct buried exterior to the building or exposed exterior to the building.

D. PVC schedule 40 shall not be used exposed or concealed in gypsum wall but may be used in CMU walls. PVC schedule 40 may be used in elevated floor slabs and in foundation slabs. Minimum concrete cover shall be ¾ inch at finished or formed surface and shall be 3 inches at concrete surface cast against earth or for slabs placed on-grade. Greater amounts of concrete cover shall be used in areas subject to damage. The placement of conduit in floor slabs must be thoroughly coordinated with the structural design. Potential conflicts with steel reinforcing bars and reductions in net concrete sections are among the issues that must be considered by the structural engineer.

3.6 Underground Raceways

A. Where conduit is installed under the ground floor slab within the building foundations, schedule 40 PVC conduit shall be used. At the Contractor's option, this installation may consist of galvanized steel conduit encased with three (3) inches of concrete or rigid steel

conduit with a minimum of 15 mils of PVC coating. Where thin wall non-metallic conduit is used under the ground floor slab, the elbows and turn out required to turn the raceway up into cabinets, equipment, boxes, etc. shall be of rigid steel.

B. Branch circuit raceways run underground external to building foundation walls shall be run in raceways installed in accordance with the NEC and shall be of a type approved by the NEC as "suitable for direct burial." Minimum raceway size shall be 1 inch.

C. All underground raceways shall be identified by underground line marking tape located directly above the raceway at 6 to 8 inches below finished grade. Tape shall be permanent, bright-colored, continuous printed, plastic tape compounded for direct burial not less than 6 inches wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.

D. Raceways run underground internal to building foundation walls shall be of a type and installed by a method approved by the NEC.

E. Where underground raceways are required to turn up into cabinets, equipment, etc., and on to poles, the elbow required and the stub-up out of the slab or earth shall be of rigid steel.

F. The raceway system shall not be relied on for grounding continuity.

G. Where passing through a "below grade" wall from a conditioned interior building space, raceways shall be sealed utilizing fittings similar and equal to OZ/GEDNEY type "FSK" thru-wall fitting with "FSKA" membrane clamp adapter if required.

**END OF SECTION 260545**

THIS PAGE IS INTENTIONALLY LEFT BLANK

**SECTION 262213 - DRY TYPE TRANSFORMERS (480V DELTA - 120/208V WYE, 3Ø, 4W)**

PART 1 - GENERAL

1.1 The Electrical Contractor shall provide dry type transformer(s) of the size and type as shown on the engineering plans.

1.2 Transformer(s) shall be manufactured by Square D or approved equivalents by ABB, Siemens or Eaton.

PART 2 - PRODUCT

2.1 Transformer(s) shall be 480-volt delta to 120/208-volt, three (3) phase, four (4) wire "Y" of the size(s) shown. Transformer(s) shall be energy efficiency type. Minimum transformer efficiencies must satisfy efficiencies promulgated within the United States Code of Federal Regulations CFR Title 10 Chapter II Part 431 (Appendix A of Subpart K 2016) commonly referred to DOE 2016 Efficiency Levels.

2.2 Transformer shall be insulated with a 220°C temperature insulation system. Transformer shall be 115°C temperature rise and floor mounted with vibration isolation pads provided. Transformer shall be capable of carrying a 15% continuous overload, without exceeding a 150°C rise. Required performance shall be obtained without exceeding the above rise in a 40°C maximum, 30°C average ambient temperature. Where floor mounted units are suspended, the type of suspension and vibration isolation shall be as detailed on the plans.

2.3 Six 2 1/2% taps, two above and four below normal shall be provided.

2.4 The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable Underwriters' Laboratory and National Electric Code standards.

2.5 The maximum temperature of the top of the enclosure shall not exceed 50°C rise above 40°C ambient.

PART 3 - EXECUTION

3.1 Transformer(s) shall be installed in accordance with manufacturer's instructions and in compliance with the National Electric Code.

3.2 Make connections to transformer(s) with a minimum of one (1) foot of flexible conduit.

**END OF SECTION 262213**

THIS PAGE IS INTENTIONALLY LEFT BLANK

## SECTION 262416 - PANEL BOARDS AND CIRCUIT BREAKER

PART 1 - GENERAL

1.1 The Electrical Contractor shall provide all panelboards and circuit breakers as shown on the plans in accordance with this specification.

1.2 All equipment shall meet UL, NEC and NEMA Standards as applicable to the equipment specified herein.

1.3 All panelboards shall be equipped with a main circuit breaker or main lugs as indicated on the drawings.

1.4 All panelboards shall be equipped with branch breakers as shown on the drawings.

1.5 All panelboards identified on the drawings for use as service equipment shall be so labeled and UL listed for such use.

1.6 Full size insulated copper neutral bars shall be included in all panelboards. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

1.7 A copper ground bus shall be included in all panelboards.

1.8 All current-carrying parts of the bus assembly shall be copper with tin plating.

1.9 Panelboards shall be labeled with a UL short circuit rating not less than the rating indicated on the drawings.

1.10 The word "spare", unless noted otherwise on the panel schedules, shall be a single pole, 20-amp circuit breaker.

1.11 The word "space", unless noted otherwise on the panel schedules, shall be for a space in the panelboard for a standard size, single pole circuit breaker.

1.12 Terminals for feeder conductors to the panelboard mains and neutral shall be UL listed as suitable for the type of conductor specified. Terminals for branch circuit wiring, both breaker and neutral, shall be UL listed as suitable for the type of conductor specified.

1.13 Sub fed breakers are not acceptable.

1.14 Series rated panel boards or breakers are not acceptable.

1.15 All NEMA 1 panel boards shall have a hinged trim (Door in Door).

1.16 All panelboards shall have breakers, terminals, and Lugs UL approved use with 75°C rated conductors.

PART 2 - PRODUCT

2.1 This section shall be for panelboards whose characteristics shall not exceed the following:

| | | | | | |
|---|---|---|---|---|---|
| Voltage | = | 240 | Maximum Branch Circuit | = | 100 amps |
| Amps | = | 600 | Short Riding Circuit | = | 22,000 amps |

A. Panelboards shall be Square D Company type NQ (bolt- on) or equivalent by Siemens, Eaton, or ABB.

B. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.

C. The panelboard bus assembly shall be enclosed in a steel cabinet. The size of the wiring gutters and gauge of steel shall be in accordance with NEMA, UL and National Electrical Code requirements for panelboards. The box shall be fabricated from galvanized steel or equivalent rust-resistant steel. Surface mounted cans shall be galvanized and without preformed knockouts.

D. Fronts shall include doors and have flush, brushed stainless steel, cylinder tumbler-type locks with catches and spring-loaded door pulls. The flush lock shall not protrude beyond the front of the door. All panelboard locks shall be keyed alike. Door shall be mounted by completely concealed steel hinges. A circuit directory frame with a clear plastic covering and a directory card shall be provided on the inside of the door. Fronts shall be of code gauge, full finished steel with rust-inhibiting primer and baked enamel finish.

E. Panelboard trims shall cover all live parts. Switching device handles shall be accessible.

2.2 This section shall be for panelboards whose characteristics shall not exceed the following:

| | | | | | |
|---|---|---|---|---|---|
| Voltage | = | 480 | Maximum Branch Circuit | = | 125 amps |
| Amps | = | 600 | Short Circuit Rating | = | 65,000 amps 480 VAC |
| | | | | = | 100,000 amps 240 VAC |

A. Panelboards shall be Square D Company Type NF (bolt- on) or equivalent by Siemens, Eaton, or ABB.

B. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.

C. The panelboard bus assembly shall be enclosed in a steel cabinet. The size of the wiring gutters and gauge of steel shall be in accordance with NEMA, UL and National Electrical Code requirements for panelboards. The box shall be fabricated from galvanized steel or equivalent rust-resistant steel. Surface mounted cans shall be galvanized and without preformed knockouts.

D. Fronts shall include doors and have flush, brushed stainless steel, cylinder tumbler-type locks with catches and spring-loaded door pulls. The flush lock shall not protrude beyond the front of the door. All panelboard locks shall be keyed alike. Door shall be mounted by completely concealed steel hinges. A circuit directory frame with a clear plastic covering and a directory card shall be provided on the inside of the door. Fronts shall be of code gauge, full finished steel with rust-inhibiting primer and baked enamel finish.

E. Panelboard trims shall cover all live parts. Switching device handles shall be accessible

2.3 This section shall be for panelboards whose characteristics shall not exceed the following:

| | | | | | |
|---|---|---|---|---|---|
| Voltage | = | 480 | Maximum Branch Circuit | = | 1,200 amps |
| Amps | = | 1,200 | Short Riding Circuit | = | 200,000 amps |

A. Panelboards shall be Square D Company, Type I-Line or equivalent by Siemens, Eaton, or ABB

B. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel are to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with NEMA, UL and NEC Standards for panelboards. Cabinets are to be equipped with spring latch and tumbler-lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. End walls shall be removable. Fronts shall be of code gauge, full finished steel with rust inhibiting primer and baked enamel finish.

C. The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breaker shall be barriered on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall be barriered.

D. A circuit directory frame with a clear plastic covering and a directory card shall be provided on the inside of the door.

2.4 Molded Case Circuit Breakers

A. This specification covers molded case circuit breakers rated 15 through 1200 amperes 120VAC, 240VAC, 277VAC and 480VAC. Breakers covered under this specification may be installed in switchboards, panelboards, motor control centers, combination motor starters, busway plugs and individual enclosures.

B. Circuit breakers shall be manufactured by Square D Company of the size as indicated on the drawings or equivalent by Siemens, Eaton or ABB. All breakers shall be bolt-on type.

C. All circuit breakers shall have a quick-make, quick- break over center toggle type mechanism. The handle mechanism shall be trip-free to prevent holding contacts closed against a short circuit or sustained overload. All circuit breakers shall assume a position between on and off when tripped automatically. Multi- pole circuit breakers shall be common trip such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Arc extinction is to be accomplished by magnetic arc chutes. All ratings shall be clearly visible.

D. Automatic operation of all circuit breakers shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. Circuit breakers shall be calibrated to carry 100% rated current in an ambient of 40 degrees Celsius. Circuit breakers shall be ambient compensating in that, as the ambient temperature increases over 40 degrees Celsius, the circuit breaker automatically derates itself to better protect its associated conductor. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes 250 amps and above.

E. The interrupting rating of each circuit breaker shall be as indicated on the drawings. The interrupting rating of the circuit breakers shall be at least equal to the available short circuit current at the line terminals of the circuit breaker and correspond to UL listed integrated short circuit current rating specified for the panelboards and switchboards.

F. UL Class A (5 milliampere sensitivity) ground fault circuit protection shall be provided on 120 V ac branch circuits as specified on the plans or panelboard schedule. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional single pole circuit breaker.

G. Motor starters, and other applications as indicated on drawings, shall be furnished with magnetic-only type molded case circuit breakers. Each breaker shall be provided with a single magnetic adjustment that will set all poles to the same trip current. Adjustment shall be continuous throughout the adjustable trip range. The magnetic trips shall be accessible from the front of these circuit breakers.

## PART 3 - EXECUTION

3.1 Panelboards shall be flush, or surface mounted as shown on the plans.

3.2 Panel enclosures shall not be used as junction or pull boxes for splicing conductors.

3.3 Each flush mounted panel shall be equipped with two empty one inch conduits sealed in the wall from a panel to a six inch square flush mounted box installed above a lay-in type ceiling or flush in the wall at the ceiling for a plaster or spline type acoustical tile ceiling.

3.4 All panels shall be equipped with neatly typed directory cards attached on the inside of the door.

3.5 GFI circuits shall be tested by the Contractor prior to the pre-final inspection.

3.6 Testing shall be performed by a qualified factory technician at the job site. All readings shall be tabulated by the contractor.

3.7 The number of branch circuit shall be identified with permanent wire tag attached to the wire.

3.8 Panelboards shall have a short-circuit current rating not less than the available fault current. The available fault current and the date the calculation was performed shall be field marked on the

enclosure at the point of supply. The label shall be of sufficient durability to withstand the environment involved.

**END OF SECTION 262416**

THIS PAGE IS INTENTIONALLY LEFT BLANK

**SECTION 262726 - WIRING DEVICES**

PART 1 - GENERAL

1.1 Switches, dimmer switches, photocell, contactors and receptacles, with proper cover plates, shall be provided where indicated on the Drawings.

PART 2 - PRODUCT

2.1 Switches, dimmer switches, photocell, contactors and receptacles shall be as specified in the Symbol Schedule of the Drawings.

2.2 All switches and receptacles shall be industrial specification grade or heavy-duty grade meeting NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL-498 and shall be approved third-party listed.

2.3 Switches and receptacles shall be as manufactured by Hubbell, Pass and Seymour, Leviton or Eaton. Photocells shall be manufactured by Tork, Paragon, Bryant, or equivalent.

2.4 Cover plates for all wall mounted devices shall be provided as scheduled on the Drawings. Where covers are not specified, they shall be as follow.

A. Interior: type 302 stainless steel. Cover plate mounting screws shall be slotted head oval screws and shall match the finish and material of the plate and shall be furnished with the plate by the plate manufacturer.

B. Exterior, exposed work and wet locations: cover plates shall be extra-duty rated (NEC 406.9(B)(1)) galvanized cast ferrous metal, standard size, and shall be single or ganged as indicated on the drawings. Exterior mounted switch and receptacle plates, and those noted to be weatherproof, shall be weatherproof cover plates, standard size, single or ganged as indicated on the drawings, and shall be "approved" third party listed as "rain-tight while in use."

2.5 All devices shall have a hex-head green grounding screw for use in connecting device to green grounding conductor run in the conduit system.

2.6 All GFI devices shall be the feed through type.

2.7 All standard duplex receptacles shall be 20-amp, 125 volt rated.

2.8 All devices subject to use in a wet location shall be listed as weather resistant.

2.9 All switches shall be rated 20-amp, 120/277 volt. Toggle switches shall have quiet operating mechanisms without the use of mercury switches.

PART 3 - EXECUTION

3.1 Mounting height shall be as indicated on the Drawings. Coordinate with other trades so that devices will miss equipment installed by others.

3.2 Where two or more devices are ganged, they shall be in a common box with a ganged plate.

3.3 All devices shall have a green ground conductor to run parallel with the phase conductor back to the electrical panel.

3.4 In all areas where carpet is to be installed as finished floor material, unless otherwise specified, the Electrical Contractor will furnish solid brass carpet flanges for installation on floor outlet boxes. Flanges will be furnished and installed on all active outlets after the carpet is installed. Where a specified number of outlet fittings are to be furnished to the Owner, for each fitting not installed during the construction period, it will be turned over to the Owner with the receptacle, carpet flange and all necessary appurtenances.

3.5 Provide quantity of 2% spare cover plates of each type to the owner.

**END OF SECTION 262726**

**SECTION 262727 - DISCONNECTS**

PART 1 - GENERAL

1.1 Disconnect switches shall be provided where indicated on the drawings, or as required by the National Electrical Code (NEC).

PART 2 - PRODUCT

2.1 Disconnects shall be heavy duty as manufactured by Square D Company, Siemens, Eaton or ABB.

2.2 Disconnects shall be furnished with factory finish paint and appropriate knockouts for conduit connections.

2.3 All disconnects shall have side hinged type doors. Front operated handles will not be permitted.

2.4 All fused disconnects shall be equipped with positive pressure fuse clips and shall have visible disconnecting blade switches.

2.5 NEMA 1 enclosures shall be provided where installed indoors. NEMA 3R enclosures shall be provided where exposed to the elements, unless noted otherwise.

2.6 All disconnects shall have copper bus.

2.7 Disconnects shall have provisions for locking in on and off positions.

2.8 Disconnects shall have defeatable door interlocks that prevent the door from opening when the operating handles is in the “on” position.

2.9 Disconnects shall have handles whose positions are easily recognizable in the “on” or “off” position. For safety reasons, padlock shall be provided for switches located in the public areas.

2.10 Required fuses shall be manufactured by Eaton-Bussman, Littelfuse, Mersen or approved equivalent.

PART 3 - EXECUTION

3.1 Disconnect switches shall be mounted as indicated on the Drawings and shall be independently supported. Conduits entering the disconnect switch shall not be used to support switches.

3.2 Where fused disconnect switches are required or shown on the plans, standard fuses shall be used unless the switch protects an individual motor circuit, then dual element fuses shall be used.

3.3 The electrical contractor shall provide to the owner the spare fuses, 10% of the quantity of fuses used of each type and rating, with a minimum of one set of each type.

**END OF SECTION 262727**

THIS PAGE IS INTENTIONALLY LEFT BLANK

**SECTION 263213 – STANDBY POWER GENERATOR SET**

PART 1 - GENERAL

1.1 The Contractor shall furnish a life safety standby power generator set as indicated on the drawings and contained herein. The generator shall comply with applicable section of NEC 700.12. The Contractor shall supply all parts for a complete, functioning generator set.

1.2 All materials, equipment, and parts comprising the units specified herein, shall be new and unused, of current manufacture and of highest grade.

1.3 The engine, generator and all major items of auxiliary equipment shall be manufactured by manufacturers currently engaged in production of such equipment. The unit shall be furnished by an authorized dealer having a parts and service facility within 150 miles of the project site.

1.4 The generator set shall be as manufactured by Caterpillar, Cummins, Kohler, or Generac.

PART 2 - PRODUCT

2.1 Generator Set Characteristics

A. Acceptable Unit: Generac SG130 or approved equivalent

B. Rating @ 1800 RPM. The rating of the engine-generator system shall be based on operation of the set when equipped with all necessary operating accessories such as radiator fan, air cleaners, etc.

1. Standby power kW with fan: 130 kW

2. Standby power kVA with fan: 163 kVA

3. Voltage 480 Volts

4. Power factor .8

5. Frequency 60 hertz

C. These ratings must be substantiated by manufacturer's standard published curves. Special ratings or maximum ratings are not acceptable.

D. Set shall be capable of continuous operation for a minimum period of 30 days without damage at the standby rating.

2.2 Engine

A. The engine shall be water cooled inline or Vee-type, four cycle compression ignition. It shall meet specifications when operating on commercially available natural gas. The engine shall be equipped with fuel solenoid shut off, gas strainer, lube oil and intake air filters; unit mounted radiator cooling, and water pump.

B. The engine electronic governor shall maintain frequency regulation not to exceed +/- 0.25% (isochronous) from no load to full rated load.

C. The unit shall be mounted on a structural steel sub- base and shall be provided with vibration control by use of integral means or spring-type isolators as recommended by the manufacturer.

D. Safety shut-offs for high water temperature, low oil pressure, overspeed, and engine overcrank shall be provided.

2.3 Generator

A. The generator shall be a salient pole brushless, synchronous alternator, continuous rated, .8 P.F., 130 kW, 163 kVA. The unit shall be the single bearing type. This assembly shall be compact, sturdy and free from vibration and with a minimum noise level. The generator rotating speed shall not exceed 1800 revolutions per minute.

B. Stator insulation shall be Class "F", rated for 80 degrees Celsius rise by resistance above a 40 degrees Celsius ambient, continuous duty. The stator windings shall be designed for an output of 3 phase, 60 hertz, 480 volts and shall have an overload capacity of 25% for two (2) hours out of any twenty-four (24) hour period.

C. The generator-exciter-regulator package shall provide a voltage regulation of plus and minus 1% of rated voltage. Voltage regulation shall apply to any load from no load to rated load at rated power factor, and is defined as a change in the output voltage after all transients, due to load change, have decayed to zero.

D. With the generator operating at rated speed, rated voltage, no-load, the sudden application of rated load, rated power factor shall not cause a transient voltage deviation of more than 15% from rated voltage. Following such a sudden load change, the voltage shall recover to and remain within the regulation band within 2 seconds.

E. Amortisseur windings with the end plates connected between poles shall be included for minimized harmonic content, good transient performance and to provide paralleling capability.

F. The bearings shall be so located as to enable replacement without disturbing the exciter-rectifier- rotor assembly. The generator shaft shall be sufficiently rigid to avoid torsional vibration. The torsional analysis of the shaft shall be done by the engine supplier. The generator shall be equipped with an adequately sized conduit box for making external connections to the connected load.

G. Voltage regulation shall be accomplished by an automatic volts-per-hertz type, solid state, exciter/regulator shock mounted inside the generator.

H. A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished which protects the generator from damage due to its own high current capability. This breaker shall not automatically reset preventing restoration of voltage if maintenance is being performed. Field current- sensing breaker will not be acceptable.

2.4 Cooling System

A. An engine-mounted radiator with blower type fan shall be sized to maintain safe operation at 110 degrees Fahrenheit maximum ambient temperature. The radiator shall be equipped with

a duct adapter flange. Air flow restriction from the radiator shall not exceed 0.5" H20. The Contractor shall provide ductwork with flexible connecting section between radiator duct flange and discharge louver frame.

B. Intake louvers shall be sized and located to provide sufficient intake air for engine combustion, ventilating air, and to provide required air flow through the radiator. These louvers shall be by the Electrical Contractor unless noted otherwise.

C. The engine cooling system shall be filled with a solution of 50% ethylene glycol.

2.5 Fuel System

A. Provide piping to the generator from the natural gas supply.

B. Flexible fuel connectors and solenoid valve shall be provided by the generator manufacturer.

2.6 Exhaust System

A. A suitable silencer of the reactive type shall be furnished with the engine. Critical 25-30 Dba reduction.

B. A stainless steel bellows type exhaust adaptor at least 18 inches long shall be furnished for each exhaust outlet to the silencer.

2.7 Automatic Starting System

A. A 12 or 24 volt DC electric starting system with positive engagement drive shall be furnished.

B. Fully automatic generator set start/stop controls in the generator control panel shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and one auxiliary contact for activating accessory items. Controls shall include a 30 second single cranking cycle limit with lockout.

C. A unit mounted thermal circulation type water heater shall be furnished to maintain engine jacket water to 90 degrees Fahrenheit in an ambient temperature of 30 degrees Fahrenheit. The heater shall be single phase, 60 Hertz, 120 volts, 1500 watts.

2.8 Batteries

A. The batteries shall be 12 volt maintenance free, lead acid type of suitable capacity to provide 90 seconds of total cranking time at 0 degrees Fahrenheit without recharging and will be rated per manufacturer's recommendation.

B. The battery will be supplied with all necessary intercell and intertray connectors, battery rack, cables, clamps, charged and ready for service.

2.9 Battery Charger

A. The charger shall be rated at no less than 10 amps and employ transistor controlled magnetic amplifier circuit to provide continuous taper charging.

B. The charger shall maintain rated output voltage with A.C. line fluctuations of +/- 10%.

C. The charger shall contain:

1. Two ranges, float at 1.4 V.P.C. and equalize at 1.6 V.P.C. on maintenance free lead acid batteries.

2. Automatic A.C. line compensation.

3. Automatic overload protection (current limiting).

4. Silicon diode full-wave rectifiers.

5. Automatic surge suppressors.

6. D.C. ammeter and voltmeter.

7. Fused A.C. input and D.C. output.

8. Low D.C. voltage alarm relay.

9. High D.C. voltage alarm relay.

10. A.C. input voltage shall be 120 volt A.C.

2.10 Generator Control Panel

A. A generator mounted NEMA 1 type vibration isolated control panel made from 14 gauge steel shall be provided on the unit, unless otherwise noted.

B. Panel shall contain, but not be limited to, the following equipment:

1. Voltmeter, 3 1/2", 2% accuracy.

2. Ammeter, 3 1/2", 2% accuracy.

3. Ammeter/Voltmeter phase selector switch.

4. Frequency meter, 3 1/2", dial type.

5. Automatic starting controls as specified in 7.b.

6. Panel illumination lights and switch.

7. Voltage level adjustment rheostat.

8. Engine oil pressure gauge.

9. Engine water temperature gauge.

10. Dry contacts for remote alarms wired to terminal strips.

11. Fault indicators for low oil pressure, high water temperature, overspeed, overcrank, and not in "auto" position.

12. Four position function switch; "auto", "manual", "off/reset", and "stop".

13. Battery charging ammeter.

14. One set of louver contacts.

15. Running time meter.

2.11 Main Line Circuit Breaker

A. A generator mounted main line molded case circuit breaker rated 200 amps shall be installed as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions. Shunt trip to activate on engine fault condition.

B. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electric Manufacturer's Association, and National Electrical Code.

C. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.

2.12 Pre-Alarm Module

A. A generator control panel mounted pre-alarm module shall be provided to meet NFPA 76A.

B. It shall provide audible and visual alarm warning of impending fault conditions and provide audible warning on fault shutdown.

C. Provide a Beacon and horn to signal fault shut down.

2.13 Provide sound attenuated weatherproof enclosure.

A. Provide emergency shut down push button located outside generator enclosure in compliance with NEC 445.18 (B).

PART 3 - EXECUTION

3.1 The generator set shall be warranted by the generator set manufacturer for one year from the date of acceptance. The warranty shall cover all parts and labor. Extended warranty and maintenance shall be made available to the Owner after the date of acceptance.

3.2 The generator set shall receive the manufacturer's standard factory load testing. Prior to acceptance of the installation, equipment shall be tested to show that it is free of any defects, and will start automatically, and be subjected to full load test, or that load which is available at the job site.

3.3 On completion of the installation, start-up shall be performed by a factory-trained dealer service representative. A letter shall be written to the Engineer from the factory-trained dealer, certifying that the system has been installed and field tested to meet the above performance requirements.

3.4 Operating and maintenance instruction books shall be supplied upon delivery of the unit and procedures explained to operating personnel.

3.5 Provide a 6" high concrete pad of sufficient size and structure to support the generator and enclosure.

3.6 For additional requirements see "Requirements for Permanently Installed Emergency Generator Systems" as published by the NC Department of Insurance. In instances where this specification conflicts with the above document, the more stringent requirement shall govern.

**END OF SECTION 263213**

**SECTION 263214 - 3-WAY MANUAL TRANSFER SWITCH (NEC 700.3 (F))**

PART 1 - GENERAL

1.1 Scope:

A. Contractor shall furnish, deliver, install and test the 3-way manual transfer switches as specified herein and in accordance with the drawings.

1.2 Quality Assurance:

A. 3-way manual transfer assembly switch shall be UL listed and labeled under the UL 1008 standard.

B. 3-way manual transfer switch shall be special seismic certified by OSHPD exclusively on the basis of approved shake table testing, and also certified to IBC 2015. Minimum IBC 2015 design parameters shall be as follows: Ip = 1.5, SDS = 2.0g, z/h = 1.0

C. 3-way manual transfer switch manufacturer shall provide a complete factory assembled, wired and tested 3-way manual transfer switch.

D. 3-way manual transfer switch shall be factory Hi-pot tested for a period of not less than 60 seconds.

E. 3-way manual transfer switch installation shall meet all applicable NEC standards.

F. 2020 NEC 700.3 (F) compliant when used in conjunction with an ATS and appropriate auxiliary equipment.

1.3 Submittals:

A. Contractor shall submit manufacturer's drawings and data of 3-way manual transfer switches for Engineer's approval prior to start of fabrication. Drawings and data shall include, as a minimum, dimensioned general arrangement drawings and wiring diagrams, UL listing information including UL file or control number, short circuit rating or withstand rating, component data, mounting provisions, conduit entry locations and installation instructions.

B. Upon installation of 3-way manual transfer switches Contractor shall submit manufacturer's Operating & Maintenance Manual which shall include as a minimum:

1. Certified as-built General Arrangement drawings and Wiring Diagram.

2. Materials / Component List including part numbers.

3. Maintenance and service requirements.

4. Certificate of Compliance and hi-pot test data.

C. Warranty:

1. 3-way manual transfer switches shall be covered by manufacturer's warranty for a minimum period of (1) one year after shipment from manufacturer.

PART 2 - PRODUCTS

2.1 General:

A. All equipment shall be new.

B. 3-way manual transfer switch manufacturer must have produced and sold UL 1008 Listed manual transfer switches as a standard product for minimum of (3) years.

C. 3-way manual transfer switches shall be molded case circuit breaker type; knife switch or fused switches are not acceptable.

D. Contractor shall be responsible for the equipment until it has been installed and is finally inspected, tested and accepted in accordance with the requirements of this Specification.

E. 3- way manual transfer switches shall be TripleSwitch as manufactured by ESL Power Systems, Inc., ASCO, TRYSTAR or equal as approved by the Engineer.

2.2 3-way Manual Transfer Switches:

A. 3-way manual transfer switch shall consist of (2) mechanically-interlocked molded case circuit breakers, and (1) independent load bank breaker with a shunt trip (shunt trip voltage to be per the drawings), male cam-style inlet connectors, female cam-style outlet connectors, power distribution blocks and grounding terminals, all housed within a padlockable enclosure.

B. 3-way manual transfer switch enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated galvanneal steel. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for both portable generator cables with female cam-style plugs and for load bank cables with male cam-style plugs shall be via a) drawn flange cable entry openings in the bottom of enclosure for wall mount units, or b) hinged lower door for pad mount units. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. Enclosure shall be powder coated after fabrication; color shall be wrinkle gray RAL 7035.

C. Cam-style male connectors (inlets) and cam-style female connectors (outlets) shall be UL Listed single-pole separable type and min. rating of 200 amps at 480VAC. All cam-style connectors shall be color coded. Cam-style connectors shall be provided for each phase and for ground, and shall also be provided for neutral. Each of the phase cam-style connectors and the neutral cam-style connectors within the enclosure shall be factory-wired to a molded case circuit breaker. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. None of the cam-style connectors shall be accessible unless all (3) molded case circuit breakers are in the “OFF” position and the main access door is open.

D. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.

E. Molded case circuit breakers shall be UL Listed 3-pole and the short circuit interrupt rating shall be a minimum of 10kAIC at 480VAC (wall mount units) or 10kAIC at 480VAC (pad

mount units). Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall control the connection between the permanent generator and the automatic transfer switch. A second circuit breaker shall control the connection between the permanent generator and the load bank female cam-style connectors. A third circuit breaker shall control the connection between the portable generator (via male cam-style connectors) and the automatic transfer switch. All (3) molded case circuit breakers shall include UL Listed door-mounted operating mechanisms, preventing the opening of the main access door unless all (3) breakers are in the "OFF" position. All (3) molded case circuit breakers shall be mounted behind a deadfront panel. The load-side of the molded case circuit breakers shall not be energizable unless the main access door is closed and one of the molded case circuit breakers is in the "ON" position. The (2) molded case circuit breakers controlling the connections between the permanent generator and the automatic transfer switch, and the connection between the portable generator and automatic transfer switch shall be safety interlocked by mechanical means to ensure that only one of these breakers can be closed at any given time.

F. An auxiliary contact shall be provided in the circuit breaker controlling the connection from the Permanent Generator to the ATS and shall be factory wired to terminal blocks within the enclosure. The auxiliary contact is provided in compliance with NEC 2020 700.3 (F)(5) which requires a means to activate an annunciator circuit.

## PART 3 - EXECUTION

### 3.1 Installation:

A. Prior to installation of 3-way manual transfer switches, Contractor shall examine the areas and conditions under which the 3-way manual transfer switch is to be installed and notify the Engineer in writing if unsatisfactory conditions exist.

B. 3-way manual transfer switch shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation".

C. Conduit entry into the 3-way manual transfer switch shall be by Contractor; Contractor shall furnish and install listed watertight conduit hubs, as manufactured by MYERS or T&B, for each conduit entry on the 3-way manual transfer switch. The incoming hub size shall match the conduit size for feeders and ground as shown on the drawings. The outgoing hub size shall match the conduit size for loads and ground as shown on the drawings. Hubs shall be properly installed and tightened to maintain Type 3R integrity of the 3-way manual transfer switch enclosure.

D. Contractor shall terminate feeder conductors, load conductors and ground per the manufacturer's instructions. All field wiring terminations shall be torqued as required per the instructions on the 3-way manual transfer switch's power distribution blocks, circuit breakers & ground lugs.

### 3.2 Field Testing:

A. Prior to energizing 3-way manual transfer switch, the Contractor shall perform the following checks and tests as a minimum:

1. Verify mounting and connections are complete and secure.

2. Verify internal components and wiring are secure.

3. Perform continuity check of all circuits.

4. Perform 1,000 VDC megger test on feeder and load cables. Prior to testing, all auxiliary circuits must be turned OFF and all fuses, microswitches and shunt trip circuits must be disconnected. It is required to take out the rating plug of any electronic trip circuit breakers while performing a megger (insulation) test.

5. Verify deadfront is secure.

6. With the 3-way manual transfer switch deadfront in place and the main access door closed and properly latched, actuate all (3) Operator Mechanisms; verify:

    a. With the breaker controlling the connection between the permanent generator and the automatic transfer switch (ATS) in the “ON” position, the breaker controlling the connection between permanent generator and the load bank can be turned to the “ON” and “OFF” position and the breaker controlling the connection between the portable generator and the automatic transfer switch cannot be turned “ON”

    b. With the breaker controlling the connection between the permanent generator and the automatic transfer switch (ATS) in the “OFF” position, the other (2) breakers controlling the connection between the permanent generator and load bank can be turned “ON” or “OFF”, and the breaker controlling the connection between the portable generator and the automatic transfer switch can be turned “ON” and “OFF”

    c. With the breaker controlling the connection between the portable generator and the automatic transfer switch (ATS) in the “ON” position, the breaker controlling the connection between the permanent generator and the automatic transfer switch (ATS) cannot be turned “ON” and the breaker controlling the connection between the permanent generator and load bank can be turned “ON” and “OFF”.

7. Confirm operation of the 3-way manual transfer switch ground receptacle by attaching a plug to the 3-way manual transfer switch ground receptacle and then verify that the plug is grounded to the facility ground.

8. Once normal power has been applied, confirm operation of 3-way manual transfer switch by following directions on main access door.

**END OF SECTION 263214**

## SECTION 263353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back up and distribution for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, battery cabinet(s), and accessory or "option" cabinet(s) for transformers, maintenance bypass, parallel tie, and distribution applications, and other features as described in this specification.

1.2 REFERENCES

A. The UPS and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL as follows. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

1. Safety

a. IEC 62040-1-1 or EN 62040-1-1

b. EN 60950

c. UL 1778

d. Cabinets are NEMA 1 and IP20 rated.

2. Emission and Immunity:

a. EN 50091-2 (Emissions Class A and Harmonics)

b. EN61000-4-2,-3,-4,-5 - Slow high energy surges in input/output lines: 1 kV. line/earth, 0.5 kV line/line (IEC 61000-4-5) - Fast low energy transients in power lines: 2 kV. line/earth (IEC 61000-4-4) - Fast low energy transients (burst) in control and signal lines: 1 kV line/earth (IEC 61000-4-4) - Electrostatic discharge (ESD): 8 kV air discharge, 6 kV contact discharge (IEC 61000-4-2) - Electromagnetic field: IEC 61000-4-3 level 3

c. FCC Class A15J

1.3 Markings

A. UL, Cul

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

A. See section 260000

1.5 QUALIFICATIONS

A. The manufacturer of the unit shall have a minimum of twenty years experience in the design, manufacture and testing of Uninterruptible Power Supplies.

B. For the equipment specified herein, the manufacturer shall be ISO 9001.

C. Provide Seismic tested equipment as follows:With optional bracing kit, the equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through zone 4 application.

1.6 REGULATORY REQUIREMENTS

A. The UPS shall be UL labeled.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 - PRODUCTS

2.1 ACCEPTED MANUFACTURERS

A. Eaton

B. APC

C. Vertiv

2.2 ACCEPTABLE UNIT: Eaton 9355 30KVA or approved equivalent

2.3 SYSTEM DESCRIPTION

Standard UPS system will include a minimum of (1) rectifier, (1) inverter, (1) static bypass, (1) maintenance bypass, and (1) battery system.

A. Components:

1. Rectifier

2. Inverter

3. Sealed Lead Acid Batteries

4. Battery Charger

5. Automatic Bypass

6. User Interface Panel

7. Serial (RS-232) Communication Interface

8. Communication Card Slots (2)

9. Remote Emergency Power Off Contacts

10. Relay Output Contact (1)

11. Environmental Inputs (2)

12. Hardwired Input, Output

13. Maintenance Bypass Module

    a. MBP internal to UPS module (standard)

    b. External MBP cabinet

14. SNMP/Web Adapter

B. Modes of Operation: The UPS shall operate as an online, double-conversion UPS with the following modes:

1. Normal During the Normal or Double-conversion Mode the rectifier shall derive power as needed from the commercial AC utility or generator source and supply filtered and regulated DC power to the online inverter. The inverter shall convert the DC power to highly regulated and filtered AC power for the critical loads.

2. Battery Upon failure of the AC input source, the critical load must continue to be supplied by the inverter without switching. The inverter must obtain its power from the battery. There must be no interruption in power to the critical load upon failure or restoration of the AC input source.

3. Recharge Upon restoration of the AC input source, the rectifier/battery charger must recharge the battery. The inverter shall, without interruption of power, regulate the power to the critical load.

4. Bypass: The static bypass switch must be used for transferring the critical load to the AC utility supply without interruption and shall be rated for continuous operation. Automatic re-transfer to normal operation must also be accomplished without interruption of power to the critical load. The static bypass switch must be capable of manual operation.

5. Maintenance bypass: A wall-mountable maintenance bypass switch is available; however, in the absence of this feature, the integral maintenance bypass switch should be used. The maintenance bypass is used for supplying the load directly from the AC utility supply, while the UPS is isolated for maintenance or repair.

## 2.4 RATINGS

A. System Input

1. Input Voltage Operation Range

    a. Nominal 208/120, 4-wire plus ground

    b. +10% to –15% from nominal

2. Input Frequency

    a. 45 to 65 Hz

    b. auto-sensing

3. Input Power Factor: 0.99 typical

4. Input Current Distortion: 5% THD maximum at full rated linear load

5. Inrush Current:

    a. <2x branch rating without input transformer

    b. <5x branch rating with input transformer

6. Surge Protection:

    a. Line to Line 180J

    b. Line to Ground 450J

B. System Output, Normal Mode -Nominal Output Voltage

1. 208/120 VAC, Selectable through front panel or through serial port connection with power management software.

2. Voltage regulation: +/-2% of selected output voltage in steady state

3. Transient Voltage Response: Meets Class 1 performance of IEC62040-3; +/-5% for 100% step load change; recovery in <1ms

4. Voltage THD:

    a. 2% Total Harmonic Distortion (THD) maximum phase to neutral into a maximum rated linear load (5% phase to phase)

    b. 5% THD maximum phase to neutral into a maximum rated non-linear load (7% phase to phase)

5. Nominal Frequency: 50 or 60 Hz selectable

6. Frequency Regulation:

a. 50/60 Hz +/- 0.5 to +/- 3.0 Hz selectable, synchronized to mains, +/- 0.005 Hz free running single units

b. +/- 0.15 Hz parallel units

7. Slew rate:

a. selectable to 1.0, 2.0, 3.0 Hz/s for single units,

b. < 0.5 Hz/s for parallel units;

c. Generator Mode (6 / 7.5 Hz/s) for single units selectable through software parameters that can be configured via LCD and service PC interface

8. Output Current: Maximum output current (at nominal output voltage) for the UPS shall be: 30 kVA system: 83 A @ 208 V.

9. Current Overload Capability without Bypass:

a. 125% for 1 min

b. 150% for 5 seconds

c. >150% for 300 ms

10. Current Overload Capability with Bypass enabled"

a. 1500A for ½ cycle

b. 1000A for 0.1 sec

c. 600A for 1 sec

11. Bypass:

a. Automatic bypass shall provide an alternate path to power in the case of overload, inverter failure or other UPS failure

b. External Maintenance Bypass can be utilized with the UPS to allow servicing of the UPS

c. Transfer time to and from any internal bypass shall be no-break

12. Efficiency: Typical >91% while in normal mode, with nominal line conditions

C. System Output, Battery Mode

1. Nominal Output Voltage: This shall be the user-selected output voltage

2. Voltage Regulation: +/-1% phase to neutral of selected nominal voltage (+/-2% phase to phase)

3. Transient Voltage Response

    a. Meets Class 1 performance of IEC62040-3

    b. +/-5% for 100% step load change; recovery in <1ms

4. Voltage THD:

    a. 2% Total Harmonic Distortion (THD) maximum into a maximum rated linear load

    b. 5% THD maximum phase to neutral into a maximum rated non-linear load (7% phase to phase)

5. Frequency Regulation: +/-0.005 Hz of selected nominal frequency

6. Overload Capacity:

    a. 125% for 1 min

    b. 150% for 5 seconds

    c. >150% for 300 ms

2.5 USER INTERFACE

A. Power Management Software Package: The UPS shall include serial communications interface that provides the following communication capabilities:

B. Monitor and graphically display input and output voltage and other operating characteristics

C. Notify end-users in the event of a power anomaly via network, E-mail or page.

D. Communication Ports:

1. Communication Card Slots: The UPS shall provide (2) communication X-slots in the back of the UPS allowing for additional connectivity options, including SNMP/Web, AS/400 relays, Modbus/Jbus capabilities, etc

2. Serial communications (via RS-232) with manufacturer-supplied power management software package

2.6 BATTERIES

A. Battery Type: Valve Regulated Lead Acid (VRLA), minimum two-year warranted float service life at 25 degrees C

B. UPS Holdover Time (Runtime): Each UPS system, consisting of a minimum of six battery strings (108 battery blocks) for each power module shall have a minimum holdover time of 11 minutes, depending on kVA rating. See product manual for detailed information.

C. Extended Holdover Time (Runtime): Each UPS system shall have capability for addition of extra matching battery cabinets (in two cabinet configurations) to increase the total holdover

time. Please refer to datasheet for a list of runtimes. The battery times listed are approximate and may vary depending on load configuration, temperature, battery age, and battery charge.

D. Battery Recharge Time:

1. Base UPS system consisting of six (6) battery strings will have a recharge time of max. 1.75 hours to 95% usable capacity @ nominal line after a full load discharge (30 kVA).

E. Bus Voltage: Nominal bus voltage is 216 VDC. Each string consists of 18 battery blocks in series with 9 Ah capacities.

F. Battery Protection:

1. Short Circuit Protection: Over-current protection shall protect the batteries from all short circuit fault conditions

2. Battery Module Protection: Internal battery circuit breaker shall be provided

3. Under-voltage Protection:

a. Inverter cutoff voltage: Battery operation shall be terminated when the battery voltage drops to the 1.67 VPC set point

b. Protective shutdown voltage: Inverter shall shutdown after 1 minute when the battery voltage drops below 1.7 VPC volts-per-cell typical

4. Over-voltage Protection: If the UPS system's battery bus voltage exceeds the predetermined set point then the UPS will disable the charger and alarm a high battery condition

2.7 ENVIRONMENTAL CONDITIONS

A. The UPS shall be certified to the following safety standards:

1. EN 62040-1-1, IEC 62040-1-1, EN 60950

B. The UPS shall meet CISPR22 Class A (EN50091-2) for Emissions and EN50091-2 (IEC6100032 for 16 amps or less) for Harmonics

C. Audible Noise: Less than 57 dBA (A weighted) at one (1) meter from all sides in all system modes

D. Ambient Temperature

1. Operating: UPS +5 deg C to +40 deg C

2. Storage: UPS 0 deg C to +25 deg C

E. Relative Humidity

1. Operating: 5 to 95% non-condensing.

2. Storage: 5 to 95% non-condensing.

3. There shall be at least a 1.8ºF (1.0ºC) difference between the dry bulb temperature and the wet bulb temperature, at all times, to maintain a noncondensing environment

4. The maximum rate of temperature change shall be limited to 3ºF over 5 minutes

5. (36ºF/hour), based on the ASHRAE Standard 90.1-2013

F. Altitude

1. Operating: To 1500 meters--de-rating or reducing operating temperature range may be required for higher altitudes

2. Transit: To 10,000 meters

G. Electrostatic Discharge: The UPS shall be able to withstand a minimum 8 kV without damage and without affecting the critical load

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

1. Standard Computer-automated UPS system test

2. Hipot test

B. INSTALLATION

1. The Contractors shall install all equipment per the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

**END OF SECTION 263353**

## SECTION 263623 - AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 The Contractor shall furnish an automatic transfer switch as shown on the drawings and as specified herein.

1.2 When an emergency generator system or prime power system is furnished as part of the work, the subcontractor furnishing the generator equipment shall furnish the automatic transfer switch.

1.3 Transfer switch(es) shall be as manufactured by Generac, Zenith, Kohler or ASCO.

1.4 The automatic transfer switch shall be contactor type, with arc suppression chutes.

PART 2 - PRODUCT

2.1 The transfer switch(es) shall be 480 volt with min. rating of 200 amp, three (3) phase, four (4) wire, four (4) pole with adjustable time-delayed neutral transfer. The transfer switch(es) shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a Nema 1 enclosure constructed in accordance with Underwriters' Laboratories, Inc. Standard UL-1008.

2.2 Automatic Operation: Transfer switch(es) shall automatically sense loss of line power whether the power has been cut off completely or simply dropped below 70% of the rated voltage level. After the loss of line power has been sensed, the transfer switch shall activate the engine start circuit and automatically transfer the load to the standby generator when power becomes available. When normal power returns, the transfer switch shall automatically transfer the load back to the normal source and signal the generator to shut down. The operating transfer time in either direction shall not exceed 1/6 of a second.

2.3 Contacts shall be silver alloy to prevent sticking and welding. Mechanism shall provide quick positive action in opening and closing circuits. All contacts and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.

2.4 The control module shall be on separate panel mounted directly below switching mechanism. Sensing and control logic shall be solid-state and mounted on plug-in printed circuit boards. Printed circuit boards shall be keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug-in type with dust covers and locking clips.

2.5 The automatic transfer switch shall conform to the requirements of Underwriters' Laboratories UL-1008 and shall be UL listed as follows:

A. For use as optional standby systems in accordance with Articles 700 of the National Electrical Code.

B. Rated in amperes for total system transfer including control of motors, electric-discharge lamps, electric- heating and tungsten-filament lamp load.

2.6 The automatic transfer switch shall be rated to withstand the RMS symmetrical short circuit current available at the automatic transfer switch terminals with the type of overcurrent protection and voltage as shown on the plans.

2.7 The transfer switch(es) shall be equipped with a manual operator that is designed to prevent injury to the operating personnel if the electrical operator should suddenly become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

2.8 The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing.

2.9 The switches shall include voltage and frequency sensing of the emergency source and shall be factory set to allow transfer to emergency when that source is at approximately rated voltage and frequency.

2.10 Approval Required

A. As a precondition for approval, the transfer switch(es), complete with timers, relays and accessories shall be listed by Underwriters' Laboratory, Inc. in their Electrical Construction Materials Catalogue under Standard UL-1008 (automatic transfer switches) and approved for use on Emergency Systems.

B. On request, the manufacturer shall provide a letter certifying compliance with all requirements of the transfer switch specifications. The certification shall identify equipment by serial number and shall include no exceptions to the specifications not stipulated with the submittal.

2.11 The automatic transfer switch shall also be equipped with an exerciser to start the generator and transfer the load for a period of thirty minutes once a week. After thirty minutes, the transfer switch shall switch back to the utility power source.

## PART 3 - EXECUTION

3.1 Sequence of Operation

A. Engine starting contacts shall be provided to start the generating plant if any phase of the normal source drops below 70% of rated voltage, after a non- adjustable time delay period of 3 seconds, to allow for momentary dips.

B. The transfer switch shall transfer to emergency as soon as the voltage and frequency have reached 90% of rated. After restoration of normal power on all phase to 90% of rated voltage, an adjustable time delay period of 0-30 minutes shall delay retransfer to normal power until it has had time to stabilize.

C. If the emergency power source should fail during the time delay period, the time delay shall be bypassed, and the switch shall return immediately to the normal source. After the switch has retransferred to normal, the engine-generator shall be allowed to operate at no load for an adjustable period of time (0-5 minutes) to allow it to cool before shutdown.

D. The transfer switch(es) shall include a test switch to simulate normal power failure, pilot lights on the cabinet door to indicate the switch closed on normal or emergency, and two (2) auxiliary contacts on the main shaft; one closed on normal, the other closed on emergency.

E. In addition, one set of relay contacts shall be provided to open upon loss of normal power supply.

F. All relays, timers, control wiring and accessories to be front accessible.

3.2 Submittal, Operator's Manual and Warranty

A. Submittal shall include specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams; dimension drawings; and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

B. Each transfer switch shall be provided with an operator's manual providing installation and operating instructions.

C. The automatic transfer switch and generator set shall be warranted by the generator set manufacturer for one year from the date of acceptance. The warranty shall cover all parts and labor. Extended warranty offers shall be made available to the Owner after the date of acceptance.

D. A letter of certification from a factory representative shall be furnished to the Engineer stating that the automatic transfer switch(es) has been installed in accordance with the manufacturer's instructions, and that the switch has been tested for compliance with the above performance requirements.

**END OF SECTION 263623**

THIS PAGE IS INTENTIONALLY LEFT BLANK

**SECTION 265100 - LIGHTING FIXTURES**

PART 1 - GENERAL

1.1 The Contractor shall provide all fixtures and lamps where indicated on the Drawings.

1.2 Work shall include all stems, canopies and accessories necessary for a complete lighting fixture installation.

1.3 No PCB ballasts shall be accepted.

PART 2 - PRODUCT

2.1 Fixtures shall be as specified in the Fixture Schedule on the Drawings or approved equivalents.

2.2 All outdoor fixtures shall bear the approved third party test label for damp or wet locations as applicable. Where the ambient falls below 50ºF that all fluorescent lamps and ballasts shall be rated for operation at 0ºF.

2.3 Unless otherwise noted, all fixtures shall be new, free of defects and imperfections. Damaged fixtures shall be replaced at this Contractor's expense.

2.4 All acrylic lenses for lay-in troffers and wrap around fixtures shall have a nominal lens thickness of 0.125” unless noted otherwise on plans.

2.5 LED Luminaries:

A. LED driver manufacturers should have a minimum of five years of experience with the manufacture of LED drivers. All drivers shall have a minimum warranty of five years.

B. Where dimming is required, fixtures shall be dimmable down to 1% with standard 120/277 volt, electronic, low voltage dimmers.

C. Minimum color rendering index (CRI) shall be 80. Color temperature and performance shall conform to the parameters established by ENERGY STAR SSL standards (refer to ANSI-C78.377-2008).

D. Optical design shall be low glare, 50% cut-off.

E. Rated for 50,000 hours at 70% lumen maintenance.

F. LED driver shall be high efficiency with a minimum power factor of .90

G. 5 year, 100% warranty coverage for the driver, LED module, housing and trim. For the 1st year this shall be a complete parts and labor warranty. The 4th and 5th years shall cover parts only.

H. Total harmonic distortion: ≤ 20% (at full luminaire output and across specified voltage range)

I. Transient and surge protection: ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kV for interior fixtures.

J. Sound: Class A not to exceed a measured value of 24dB.

K. Maximum standby power: 1W

L. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 10% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.

2.6 Emergency and exit light:

A. The entire unit shall be warranty for three years.

PART 3 - EXECUTION

3.1 All fixtures shall be installed in accordance with the National Electric Code.

3.2 All fixtures other than the lay-in type shall be individually supported from building structure with 1/4" threaded rods and nuts.

3.3 Where a recessed or downlight fixture replaces a section or part of a ceiling tile, fixture is to be supported at the two (2) opposite ends to the steel frame of the building. Supports shall be provided with the same type of wire as used to support the lay-in ceiling track. Attach one end of the wire to one corner of the luminaire and the other end to the building's structural system. The lay-in luminaire shall then be screwed to the main runners of the lay-in ceiling track at all four (4) corners using sheet metal screws. For fire rated suspended ceiling, luminaire shall be supported to the Building Structure as per the Ceiling Design Criteria, luminaire shall then be screwed to the main runners of the suspended ceiling track at all four (4) corners using sheet metal screws.

3.4 The complete emergency lighting system shall be tested by throwing the circuit breakers feeding the emergency lighting circuits. One and one-half hours thereafter, the battery voltages shall be recorded in a report to be submitted to the Engineer

**END OF SECTION 265100**

**SECTION 270000 - TELECOMMUNICAITON DISTRIBUTION SYSTEM**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The Contractor shall provide the required protection in accordance with the requirements of these specifications and NEC 2020, Article 800. The protection shall be provided on both ends of all inter-building cables where required by code or otherwise indicated in the contract documents (i.e., building-to-building, building-to-modular classroom, or building-to-modular complex).

1.2 SUMMARY

A. This Section includes a Telecommunications Distribution System which is ready for the installation of active electronic equipment such as hubs, routers, bridges, switches, repeaters, adapters, etc. The system shall incorporate all requirements of this specification.

1.3 CONTRACTOR DELIVERABLES

A. The contractor will need to coordinate the installation of the telecommunications cabling with the general contractor. Cable shall not be installed until the building is secured.

B. The Contractor shall prepare and provide two (2) copies of the following documentation for review and approval by the Engineer:

1. A labeled cable plant drawing.

2. Work Area Floor Plans - Include detailed cable routes and labeling plan for all work areas. The Contractor may obtain floor plans from the Architect in AutoCAD format, if so desired, to aid in preparing the submittal.

3. Upon completion of the project, the Contractor shall prepare "As-Built" documentation showing actual site conditions and installation as constructed, and provide copies of such documentation as per paragraph A.3.b.

4. In addition to the engineering diagrams, the following items shall be provided by the Contractor at substantial completion:

   a. Laminated cable schedule, sized 8-1/2 “x 11”.

5. Record of field tests of System

   a. The data TCO identification numbers in recording test results shall be the same as those shown on the “As-Builts” and cable schedules.

6. Technical Support Staff and Experience

a. The Contractor shall provide a list of its project management staff and technical support staff to be assigned to this project together with their resumes and working experience.

b. The Contractor shall utilize certified cable installers and technicians with approved vendor specific certification. The Contractor shall supply certification documentation for cable installers.

c. The Contractor shall state their nearest branch office and dealer's office in relation to the proposed site of the cabling system. If none, the location of the main office shall be stated.

d. The Contractor shall state their nearest location of their principal support center. This center shall have permanently stationed support staff that is capable of providing technical support if required.

7. System Warranty

a. The Contractor shall provide a five (5) year warranty for both products and labor.

b. Service must be provided within twenty-four (24) hours of notification for emergency situations and within seventy-two (72) hours for routine service.

1.4 PRODUCT SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

1. Product data for system components

1.5 QUALITY ASSURANCE

A. Comply as applicable with ANSI/TIA-568-E, "Commercial Building Telecommunications Cabling Standard", most recent addition.

B. Comply as applicable with ANSI/TIA-569-E, "Commercial Building Standards for Telecommunications Pathways and Spaces", most recent addition.

C. Comply as applicable with ANSI/TIA-606-D, "The Administration Standard for Telecommunications Infrastructure of Commercial Buildings," most recent addition.

D. Comply with NFPA 70, "National Electrical Code," 2020.

E. "Nationally Recognized Testing Laboratory" (NRTL) Listing: Provide materials that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

3. FCC Regulations: Comply with FCC Part 68, Chapter 1, "US Code of Federal Regulations," Title 47 for all telephone system wire and cable connection components.

PART 2 - PRODUCTS

2.1 BACKBONE CABLE: Contractor shall provide all backbone cable inside building.

A. FIBER OPTIC CABLE

1. All cables shall conform to or exceed the ANSI/TIA-568.3-E Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling Components Standard.

2. The multi core optical fiber shall consist of multimode 50 micron fibers, OM4.

3. The fiber cable shall meet the NEC requirements for OFN, OFNR or OFNP and comply with Bellcore, FDDI, ANSI/TIA-568.3-E and ICEA standards.

4. Connectors shall be crimp-on type, pre-polished LC connectors or hot melt.

5. Cable shall be rated for indoor/outdoor and wet location.

6. Acceptable manufacturers: Corning Fiber, CommScope, Belden

2.2 HORIZONTAL CABLE: Contractor shall provide all horizontal cables.

A. CATEGORY CABLE (CAT6A)

1. All cables shall be composed of 4-pair 23 AWG solid copper conductors.

2. All cables shall conform to the following standards to support requirements for UTP at 500 MHz and Power over Ethernet (PoE++):

a. ANSI/TIA-568.2-D Category 6A

b. IEEE 802.3bt Type 1, Type 2, Type 3, Type 4

3. Cables shall be capable of supporting 10GBASE-T

4. The cable shall be Underwriter’s Laboratories Inc. (UL) listed type MPR, MPP, CMR, and CMP.

5. Cable shall be plenum rated.

6. Acceptable manufacturers: CommScope, Belden, Panduit.

B. CATEGORY CABLE (CAT6)

1. All cables shall be composed of 4-pair 23 AWG solid copper conductors.

2. All cables shall conform to the following standards to support requirements for UTP at 250 MHz and Power over Ethernet (PoE++):

a. ANSI/TIA-568.2-D Category 6

b. IEEE 802.3bt Type 1, Type 2, Type 3, Type 4

3. Cables shall be capable of supporting 1000BASE-T, 100BASE-TX, 10BASE-T

4. The cable shall be Underwriter's Laboratories Inc. (UL) listed type MPR, MPP, CMR, and CMP.

5. Cable shall be plenum rated.

6. Acceptable manufacturers: CommScope, Belden, Panduit.

2.3 TELECOMMUNICATIONS OUTLET (TCO)

A. Shall be modular, RJ45 type/8 position/8 conductor.

B. Shall be universal application/multivendor supportive accepting most phone and data plugs.

C. Modular connectors shall be flush with outlet faceplate.

D. Cover to match those indicated for power receptacle outlets in same spaces for materials and finish.

E. Outlets shall be wired in T568B pinout configuration.

F. All outlets shall be listed for CAT6A application and utilize cross-over lead technology to address data circuit applications up to 500 MHz and conform to or exceed the ANSI/TIA 568.2-E transmission standard up to 10 Gbps.

G. Acceptable manufacturers: Siemon CommScope, Belden, Panduit.

2.4 PATCH PANEL

A. FIBER OPTIC PATCH PANEL

1. The panel shall support shall be with LC connectors.

2. Acceptable manufacturers: Corning Fiber, CommScope, Belden, Panduit.

B. CAT6A PATCH PANEL (48-Port)

1. The panel shall support the Category 6A applications and facilitate cross-connection and inter-connection using patch cords.

2. The wiring blocks shall be fire-retardant, molded plastic consisting of horizontal index strips for terminating conductors. These index strips shall be marked with four colors on the high teeth, separating the tip and ring of each pair, to establish pair location.

3. The panel shall be able to accommodate over 500 repeated insertions without incurring permanent deformation and it shall pass the reliability test of no more than one contact failure in 10000 connections.

4. 19" rack mountable patch panels shall be used. Patch panel installations shall contain a retaining trough between every 100 pair termination block.

5. The panel shall be able to accommodate 23 AWG cable conductors.

6. The panel shall be Underwriter's Laboratories (UL) listed.

7. Shall be wired in a T568B pinout configuration.

8. All jacks shall be listed for CAT6A application and utilize cross-over lead technology to address data circuit applications up to 500 MHz and conform to or exceed the ANSI/TIA 568.2-E transmission standard up to 10 Gbps.

9. Acceptable manufacturers: Siemon CommScope, Belden, Panduit.

2.5 19 INCH FREE STANDING RACK

A. Chatswoth: 46053-703 or equal by Tripp Lite (Eaton), APC (Schneider Electric),

B. Provide 2 post rack with cable management. The rack must provide a space on both sides for cable management.

1. Front Horizontal wire management: Panduit NetRunner or equal.

2. Rear Horizontal wire management: Panduit NetRunner or equal

3. Wire management bracket: Panduit or equal.

C. Unit to be open steel configuration. Unit shall be heavy-duty construction and be mounted on floor.

D. Unit to be self-supporting.

E. Unit to be fully compatible with EIA 1 ¼" – ½" alternating hole patterns.

F. Provide clear finish over surface to inhibit oxidation.

2.6 19 INCH RACK ENCLOSURE

A. APC: AR3350B2 or equal by Tripp Lite (Eaton), Chatsworth,

B. Provide Rack Enclosure with the following requirements:

1. Rack width: 19"

2. Number of rack unit: 42U

3. Maximum Mounting Depth 41.3"

4. Minimum Mounting Depth: 11.3"

5. Suitable for server equipment.

2.7 WALL RACK ENCLOSURE:

A. Chatsworth: 11900-X48 or equal by Tripp Lite (Eaton, APC (Schneider Electric).

B. Provide Wall Rack Enclosure with the following requirements:

1. Rack width: 19”

2. Number of rack unit: 26U

2.8 METERED PDU WITH POWER STRIP

A. PDU for 19” free standing rack.

1. Eaton: PDUMNV30LX or equal by Chatsworth, APC

2. NEMA L5-30P input, 2.9 kW, 24A max.

3. (24) 5-20R outlets.

B. PDU for wall rack enclosure.

1. Chatsworth: EA-3243-C or equal by Eaton, APC

2. 1U PDU, NEMA L5-20P input, 1.9 kW, 16A max.

3. (12) 5-20R outlets.

2.9 CABLE TRAY:

A. Cable tray shall be tubular stringer style. Eaton: B-LINE series or equal.

B. Width of tray shall be per plans.

2.10 TERMINATION LABELS

A. Shall conform to ANSI/TIA-606-D. Labels will have pressure sensitive, permanent acrylic type adhesive, P-Touch type weatherproof or equal.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Contractor shall maintain conductor polarity (tip and ring) identification at the MDF and station connecting blocks in accordance with industry practices.

B. The Contractor shall provide all cables. All communication cable installed by the Contractor shall be fully tested in accordance with ANSI/TIA-568-E series standard prior to acceptance.

C. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, wiring duct (MDF & IDF locations), miscellaneous grounding and support hardware,

etc., necessary to facilitate the installation of the System in a neat and orderly fashion as approved by the Engineer.

D. It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the System. This may include, but is not limited to, tools for terminating cables, testing and splicing equipment for copper/fiber cables, communication devices, jack stands for cable reels, or cable winches.

E. The Contractor shall be responsible for printed labels for all cables and cords to the specifications. No labels are to be written by hand including numbers on boots. Approval must be obtained from the engineer for labeling devices used.

F. The Contractor shall not place or attach any telecommunications cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.

G. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines will require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

H. The Contractor shall be responsible for providing an approved ground at all newly installed distribution frames, and insuring proper bonding. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes and framework. All grounds and bonding shall consist of green #6 AWG solid copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground.

I. The Contractor shall furnish to the Owner all closeout documentation in a three-ring binder with proper labeling on cover and the end of the binder.

## 3.2 INSTALLATION, GENERAL

A. Distribution System: The contractor is responsible for the back to the new communications closet.

B. Raceway: Install service and distribution raceway for all cabling as indicated.

C. Conduit sleeves for Computer Network Infrastructure shall be installed not more than four inches (4") from wall and shall be stubbed at a maximum of four inches (4") above or below finished floor. Plastic bushings and pull wires shall be provided.

## 3.3 HORIZONTAL CABLE INSTALLATION

A. Obtain approval of all raceway system installation from engineer prior to installing any cable. Install cable without damaging conductors or jacket. Do not bend cable to a smaller radius than minimum recommended by manufacturer. Do not exceed manufacturers recommended pulling tensions. Pull cables simultaneously where more than one is being installed in the same raceway or at the same location. Use pulling compound or lubricant where necessary.

Compound used must not damage conductor or insulation. Use pulling methods that will not damage cable or raceway, including fish tape, cable, rope and wire-cable grips.

B. Wiring Method

1. New Construction: Install outlet boxes at outlets. Install cable in raceway in wall. Terminate raceway with a bushing in ceiling space above nearest cable tray. Run cable supported by “J” type hooks along walls to deck or in cable tray in accessible ceiling space.

2. Provide bushings on all conduits stubbed to ceiling void.

3. Copper Cable above finished ceilings: Install parallel or perpendicular to surfaces or exposed structural members and follow surface contours where possible. Install cables in approved supports on walls, not diagonally across ceiling void. All cables shall be routed and supported around the exterior walls of the room in a consistent pattern, with all break-outs being 90-degree angled turns without any corners being cut.

    a. Cable Support: Secure cable to independent supports at intervals as required by current industry standards, that prevents sagging between supports. Use metallic supports with corrosion resistant finish. Please provide separate cable pathways for all Technology related cabling and all other low voltage cabling.

    b. Splices: Do not splice any cable between the normal terminations of runs.

    c. No Dropped Ceiling (Exposed Ceilings): Route in conduit along structure. Min. conduit size is ¾”.

    d. Attach cable to building structure only as per NEC Article 800.

    e. Technology related cables installed in cable tray shall be separated from all other low voltage cabling by dividing the tray into two distinct sections.

    f. Technology related cabling installed in “J” type hooks” shall be separated from all other installed low voltage cabling. This means a separate installed “J” type hook pathway should be provided for all non-technology related low voltage cabling.

4. In suspended ceiling and raised floor areas where walker duct, cable trays or conduit are not available, the Contractor shall bundle horizontal Cat6 and Cat6A wiring with wire ties at appropriate distances. The cable bundling shall be supported via "J" type hooks or Cat6 bridle rings with saddles attached to the existing building structure and framework. Adhering to industry standards concerning cable fill capacity for cable type being utilized. Use of Velcro straps is prohibited.

C. The 4-pair UTP cables shall be installed using a star topology format from the administration subsystem on each floor to every individual TCO.

D. The length of any horizontal Cat 6 or Cat 6A cable shall not exceed 295-ft (90 m).

E. Conduit installed by the Contractor should not exceed one hundred feet (100') or contain more than two (2) ninety-degree (90°) degree bends without utilizing appropriately sized pull boxes.

F. No Condulets may be used.

G. Cabling in Telecommunications Sub closets and Cabinets: Install conductors parallel to and at right angles to walls. Bundle, lace and train the conductors to terminal points with no excess. Use wire distribution spools at points where cables are fanned or conductors turned. Connect conductors that are terminated, spliced or interrupted to terminal blocks.

H. Conductor Terminations: Terminate conductors of cables on terminal block using tools recommended by terminal block manufacturer.

## 3.4 TELECOMMUNICATION OUTLET (TCO)

A. Unless otherwise noted on the floor plans, the TCO shall be flush mounted.

B. Outlet jacks shall be color keyed blue for data.

C. Wireless Access Point and Camera drops shall be installed as shown on plan with a minimum twenty (20') service loop in ceiling areas containing acoustical ceiling tiles and terminated on RJ45 keystone-type jacks enclosed in a surface mount style box installed in and extended to the patch panel in the nearest designated IDF closet. Each biscuit jack installed shall be labeled with the complete label designation for that individual cable drop on the outside cover of biscuit jack and on adjacent ceiling grid.

## 3.5 FEEDER CABLE

A. Contractor shall obtain approval of all raceway systems installation from the engineer prior to installing any cable.

B. All fibers shall be installed in raceway (inner duct or armored fiber) and terminated with approved pre-polished, crimp-on LC-style connectors or hot melts at termination or distribution enclosures or at termination shelves equipped with sufficient panels, adapters and jumper storage to terminate and secure all fibers.

C. The fiber cable shall be protected by optical fiber raceway or appropriate apparatus at all times. Each end of the fiber cable shall contain a slack storage box with approximately six feet (6') of cable slack.

D. All copper voice feeder cable shall be terminated in a one (1) pair per port configuration. The feeder cable shall be terminated on the WHT/BLU and BLU/WHT connector of the Cat6A patch panel.

## 3.6 OUTSIDE CABLE

A. All buried cable shall be contained in a raceway system. When using PVC, a metallic locating tape shall be installed a minimum of twelve inches (12") below grade. See plans for other depths required.

B. Contractor shall obtain approval of all raceway system installation from the engineer prior to installing any cable.

C. Provide hand holes on all underground inter building (between buildings) conduit runs that change direction. There shall be no more than 500 feet between hand holes.

D. Contractor shall provide electrical lightning/surge protection panels and protector units on copper cables that will prevent electrical surges on the cable from entering buildings.

E. It shall be the responsibility of the Contractor to stake all areas along the cable route forty-eight (48) hours prior to any trenching or digging.

F. The Contractor shall be responsible for restoring any disturbed earth to its original condition. A reasonable effort shall include any landscaping, seeding, or replacement of shrubbery that may be required to properly restore the excavated area. If settling should occur, the installation Contractor shall be responsible for any secondary restoration.

3.7 GROUNDING

A. Communications Systems - In compliance with NEC 2020, Article 800.

1. See plan for detail.

B. Contractor shall install a copper busbar at the new telecommunication board for grounding of communication systems.

3.8 IDENTIFICATION

A. Provide identification in accordance with the recommendations of ANSI/TIA-606-D. “Administration Standard for Telecommunications Infrastructure.” Refer to labeling descriptions below.

B. Contractor shall field verify labeling scheme with the Pitt County IT department for the requirements. Submit the labeling schedule to the Pitt County IT department for approval prior to making the labels.

3.9 FIELD QUALITY CONTROL

A. Test Notice: Provide at least 10 days' notice in writing when the system is ready for final acceptance testing.

B. Acceptance Tests: Include the following for each pair or conductor of each cable run.

1. 100 percent of the horizontal and riser wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage.

2. Data horizontal wiring pairs shall be tested from the TCO to the patch panel or block, the basic link test.

C. Data cables shall be tested for conformance to the specifications of ANSI/TIA-568.2-D for Cat6A copper cable.

1. Wire Mapping shall be done to ensure proper wiring and connectivity. Test for:
    a. Continuity, end-to-end.
    b. Shorts between any two or more conductors.
    c. Crossed pairs
    d. Reversed pairs
    e. Split pairs
    f. Other mis-wirings
    g. Document as Pass / Fail
2. Length shall be measured. Indicate the length of the cable as the pair with the shortest length and record it
3. Attenuation shall be tested with a remote signal injector and a reading made at the local end. Evaluate the worst pair attenuation and record result on test report.
4. Bi-Directional NEXT. Near-end crosstalk (NEXT) shall be tested on all six pair combinations in each four pair cable. Tests for NEXT shall be performed from both the work area outlet location and link origination point.
5. Computer generated test results must be submitted to the Architect.
6. Re-testing: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify that the total system meets the Specifications and complies with applicable standards.
7. Report of Tests and Inspections: Prepare a written record of inspections, tests, and detailed test results in the form of a test log and format the log in cable ID number order.

**END OF SECTION 270000**

THIS PAGE IS INTENTIONALLY LEFT BLANK

**SECTION 283100 – ADDRESSABLE FIRE ALARM SYSTEM**

PART 1 - GENERAL

1.1 This document includes the furnishing, installation, and connection of the microprocessor controlled; intelligent reporting fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring.

1.2 The fire alarm system shall comply with applicable provisions of the NC Building Code, NFPA 70 - National Electrical Code (NEC), NC Fire Code, and NFPA 72 -National Fire Alarm and Signaling Code. The Contractor shall furnish all parts, materials, and labor customarily required or provided for a complete and operating system, in accordance with all requirements applicable, even if each needed item is not specifically shown or described in the project plans or specifications.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled. Products of firms that do not maintain factory authorized service organization and spare parts stock are not acceptable for use

B. Acceptable Manufacturers: Simplex, EST, Siemens, FireLite, Notifier or other approved equivalents.

C. Installer’s Qualifications: Company specializing in performing the work and making the final terminations and connections. Minimum of 5 years documented experience installing fire detection and alarm systems similar in size and scope to the project. Only the Installer may make program changes and must be present for the 100% test, Designer’s pre-final review and Owner inspections.

D. All connections to the FACP and the system's programming shall be done only by the manufacturer, or by an authorized distributor that stocks a full complement of spare parts for the system. The technicians are required to be trained and individually certified by the manufacturer, for the FACP model/series being installed. This training and certification must have occurred within the most recent 24 months, except that a NICET Level III certification will extend this to 36 months. Copies of the certifications must be part of the Shop Drawing submittal to the Designers, prior to installation. The submittal cannot be approved without this information.

E. NFPA Compliance: Comply with applicable requirements of NFPA-72, National Fire Alarm and Signaling Code.NEC Compliance: Comply with applicable requirements of NFPA-70, National Electrical Code (NEC) standards pertaining to fire alarm systems.

F. Comply with applicable requirements of NC Building Code and NC Fire Code.

G. Testing Laboratory Compliance: Comply with provisions of UL safety standards pertaining to fire alarm systems. Provide products and components which are Listed and Labeled.

H. FM Compliance: Provide fire alarm systems and accessories which are FM approved.

1.4 Definitions:

A. Authority Having Jurisdiction (AHJ).

1. The AHJ for code compliance is the Pitt County Fire Marshal. The contractor shall field coordinate all permits and site inspections with the AHJ.

2. Fire Alarm Control Panel (FACP) - Also called a Fire Alarm Control Unit (FACU) by some entities. See requirements in Part B.

3. Remote Annunciator (FAA) – Provides LCD display with a text statement of the panel status and/or LED lamps to indicate the status of the fire alarm system. It is provided to assist fire fighters who respond to a call and to assist technicians who respond to a trouble condition.

1.5 Submittals

A. Submittals shall address interface with other significant electrical subsystems (e.g. electrically controlled smoke dampers, door holders, smoke evacuation and smoke control systems, security lock door hardware, etc.).

B. Shop Drawings:

1. The fire alarm contractor shall submit complete Shop Drawings to the engineer for review, prior to submitting to the AHJ for installation permit. They shall clearly demonstrate compliance with the engineer’s plans and specifications, which have a System Response Matrix showing the fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal. Any non-compliant features must be fully described. Shop drawing submittals shall provide mA draw for each device submitted and the listed minimum voltage required to operate. Panel submittal shall list voltage drop allowed for panel and for individual NAC circuits.

2. The submitted shop drawings shall show equipment, device identification numbers and locations, and connecting wiring of entire fire alarm system. Include wiring and riser diagrams. Wiring diagrams shall be based on the project floor plans, with devices and proposed conduit routing. The conductor composition for each conduit section shall be provided. The distance and route for each NAC (Notification Appliance Circuit) shall be shown. Riser diagrams shall show consecutive connections for all devices with addresses and candela and Candela ratings.

3. Engineer’s approval (with or without corrections) of contractor’s Shop Drawings, samples, cut sheets, etc., is for general conformance with the contract documents and design concept. It shall not relieve the contractor of responsibility for full compliance with the project plans and specifications, EXCEPT for any specific non-compliant features for which the engineer gives written authorization.

4. Installation Instructions: The contractor shall submit to the engineer of record the Manufacturer's detailed installation instruction for the Fire Alarm Control Panel and all

duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.

5. Battery and Voltage Drop Calculations:

   a. Include a copy of system battery sizing calculations with the shop drawing submittal to the engineer. Use manufacturer's battery discharge curve to determine expected battery voltage after 60 hours of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at End of the Line Resistor (EOL), based on conductor resistance per conductor manufacturer's data sheet or NEC.

   b. Fire Alarm Vendor’s calculations must be submitted with the shop drawings, and prior to installation of equipment. In the submittal package identify Notification Appliance Circuits (NAC) current draws and voltage drops for each circuit. Vendor must utilize the “end offline” method for voltage drop calculations. The “mid-point” method is not acceptable. In no case shall the calculated voltage at any notification appliance fall below the minimum listed operating voltage for the devices used.

   c. The voltage drop at EOL must not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. (Typically, for a 24-volt system, this limits the voltage drop from the battery to the EOL to 3 volts). Determine "worst case" voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result must be no less than the minimum listed operating voltage for the alarm notification appliances used. All these calculations must be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technicians.

   d. Provide copies of battery and voltage drop calculations at final inspection.

C. Maintenance Data: The contractor shall submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual.

D. Maintenance Contract: The contractor shall submit a quote for a maintenance contract to provide all maintenance, test, and repair described below and/or in accordance with NFPA-72, "Guide for Testing Protection Signaling Systems". Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of two (2) years after expiration of the guaranty. Maintenance and testing shall be on a semiannual basis or as required whichever is the most restrictive. A preventive maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventive maintenance. The schedule shall include:

   1. Inspection and testing of the fire alarm system in accordance with the requirements of NFPA 72 Chapter 14

E. Certifications:

1. Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses, and telephone numbers in the certification.

2. Installer's training certificate as defined under Quality Assurance.

PART 2 - PRODUCT

2.1 FIRE ALARM CONTROL PANEL (FACP)

A. FACP - General: The FACP shall meet the following general requirements (unless otherwise required by the owner for certain systems):

1. The system is to be the addressable type, with a 24vdc nominal operating voltage.

2. The system is to have multiple access levels so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. The process on how to do this must be included in the training required to be given to the owner's designated personnel, and must also be part of the written documentation provided by the fire alarm equipment supplier.

3. Signal Line Circuits: (SLC) also called addressable circuit - Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto a Class B Signaling Line Circuit (SLC) with no "T" taps.

4. Initiation Device Circuits: Initiation Device Circuits (IDC) shall be wired Class B.

5. Notification Appliance Circuits: Notification appliance circuits shall be wired Class B.

6. Digitized electronic signals shall employ check digits or multiple polling. In general a single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

7. Loss of Power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

8. The FACP must have an Alarm Silence switch and be equipped with the Subsequent Alarm (alarm resound) feature. Any remote annunciators or graphic displays located away from the alarm area must also include an audible signal with alarm resound feature.

9. FACP - Minimum Requirements: The FACP shall contain a microprocessor based Central Processing Unit (CPU). The CPU and its associated equipment shall be protected so it cannot be affected by voltage surges or line transients consistent with UL standard 864. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, local and remote operator terminals, printers, annunciators, and other system-controlled devices. The main FACP shall perform the following functions:

a. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

b. Supervise all initiating, signaling, and notification circuits throughout the facility by way of connection to monitor and control modules, or end of line resistor.

c. Visually and audibly annunciate any trouble, supervisory or alarm condition on operator's terminals, panel display, and annunciators.

B. System Response to an Alarm Condition: When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

1. The system alarm LED shall flash.

2. A local piezo-electric signal in the control panel shall sound.

3. An 80-character minimum LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

4. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated. Exact programming shall be provided by the Contractor to meet the Owner’s requirements.

5. Detect activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

6. Activate all fire alarm Notification Appliances in the building, sounding and flashing in synchronization continuously until the initiating device and control unit have been reset to normal condition.

7. Activate digital alarm communicator.

8. Deactivate control relays so that HVAC units shut down. Exception is for hazardous exhaust systems and smoke control.

9. Activate elevator recall sequence if smoke is detected in any elevator lobby, shaft, or in the elevator equipment room.

10. Activate control relay(s) to release all magnetically locked egress doors.

C. System Response to a Trouble Condition:

1. Systems AC power trouble signal shall not be sent unless maintained for 1 to 3 hours (or more) Provide additional relays as required for this purpose.

2. Provide immediate transmission of all other supervising signals.

3. Provide adjustable time delay for all other trouble signals prior to transmission.

D. System Capacity and General Operation: The system shall have the following capacities and general operation modes:

1. The FACP shall be capable of 198 intelligent/addressable devices per Signaling Line Circuits (SLC). The number of SLCs provided shall be as indicated on the Drawings. Total points shall be as indicated on the drawings or otherwise specified with minimum 20% spare capacity.

2. The FACP shall include a full featured operator interface control and annunciation panel that shall include a backlit, 80 minimum character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.

3. All programming or editing of the existing program in the system shall be achieved with a personal computer on site. A copy of the database shall be left in the Document Box per NFPA 72.

4. Notification Appliance Circuits with 20% spare capacity.

E. The FACP shall be able to provide the following features:

1. Upload/Download to PC Computer

2. Charger Rate Control

3. Drift Compensation

4. Automatic Day/Night Sensitivity Adjust

5. Device Blink Control

6. Pre-alarm Control Panel Indication

7. Trouble Reminder

8. NFPA 72 Smoke Detector Sensitivity Test

9. System Status Reports

10. Periodic Detector Test

11. Alarm Verification, by device, with tally

12. Non-Alarm Module Reporting

13. Block Acknowledge

14. Smoke Detector Maintenance Alert

15. Control-By-Time

F. The control panel shall be capable of printing historical data and device parameters and shall include all equipment necessary to produce printouts, including an external printer and shall be U.L. listed as meeting the NFPA 72 sensitivity testing and maintenance requirements without the need for manually removing and testing each smoke detector. The control panel shall provide a display and a printed list of these sensitivity measurements as a permanent record of the required sensitivity testing. The system shall also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.

G. The system shall perform time-based control functions including automatic changes of specified smoke detector sensitivity settings.

H. Central Processing Unit: The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.

1. The CPU shall contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure. The CPU shall also provide a real-time clock for time annotation of all system displays. The Time-of-Day and date shall not be lost if system primary and secondary power supplies fail.

2. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

I. Operators Control: Provide an operator's interface which allows the following minimum functions. In addition, the operator's interface shall support any other functions required for system control and/or operation:

1. Acknowledge (ACK/STEP) Switch

2. Signal Silence Switch

3. System Reset Switch

4. System Test Switch

5. Lamp Test Switch

6. Programmable, supervised switches for fire safety function bypasses. i.e. NAC Bypass, Elevator Capture Bypass, HVAC Shutdown Defeat, Smoke Control Bypass, etc. Switch operation shall be password protected.

J. Display: The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters. The display

assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.

1. The system display shall provide an 80minimum -character back-lit alphanumeric Liquid Crystal Display (LCD).

2. The Display shall also provide four Light-Emitting-Diodes (LEDs), that will indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, and SIGNAL SILENCE.

3. The system display shall provide a touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

K. Signaling Line Circuit (SLC) Interface Board: The FACP shall contain SLC interface boards as required to communicate with the SLC. Each SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 analog detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.

1. Each SLC interface board shall contain its own microprocessor and shall be capable of operating in a local mode (any SLC input activates all or specific SLC outputs) in the event of a failure in the main CPU of the control panel. The SLC interface board shall not require any jumper cuts or address switch settings to initialize SLC circuit operations. SLC interface boards shall provide power and communicate with all intelligent addressable detectors and modules connected to its SLC circuit on a single pair of wires.

2. Each SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that specific detector. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

L. Remote Transmissions: The FACP shall be interfaced to a Digital Alarm Communications Transmitter (DACT).

M. Power Supply: The FACP power supplies shall operate on 120 VAC, 60 Hz and shall have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage. Further, the power supply shall be expandable for additional notification appliance power in 3.0 Ampere increments.

N. The power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge.

O. Batteries: Shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have enough capacity to power the fire alarm system for

not less than 24 hours plus 5 minutes of alarm upon a normal AC power failure. NAC circuits shall not exceed 75% of maximum current load allowed.

P. Enclosures: The FACP shall be housed in a 3rd party listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).

2.2 ALARM APPLIANCES

A. Programmable Electronic Sounders: Sounders located outdoors shall be listed for use in wet locations. Electric sounders shall operate with synchronized audible output and have the following specifications:

1. Voltage: Programmable electronic sounders shall operate on 24 VDC nominal.

2. Programming: Electronic Sounders shall provide the ANSI S3.41 three-pulse temporal pattern audible evacuation signal, described in NFPA 72, with an output sound level of at least 90 dBA measured at 10 feet from the device. Output sound level shall be 110 dB maximum. Electronic Sounders shall be field programmable without the use of special tools.

B. Strobe Lights shall be located as shown on the Drawings. Strobe lights indicated for use exterior to the building shall be mounted at the indicated elevation and listed for use in wet locations. Strobe lights shall operate with synchronized flash output and have the following specifications:

1. Voltage: Strobe lights shall operate on 24 VDC nominal.

2. Maximum pulse duration: 2/10ths of one second.

3. Strobe intensity and flash rate: Must meet minimum requirements of UL 1971. Provide strobe lights with minimum intensity Candela (Cd) rating of 15 Cd, or greater if such is indicated adjacent to the device symbol on the Drawings. The Fire Alarm Contractor shall verify all candela settings prior to conducting the voltage drop testing required later in this document. Contractor shall also verify the design candela settings are adequate for the space being covered. Care must be taken to assure the devices are mounted in the exact locations shown on the approved shop drawing documents. Notify the designer of any deficiencies.

4. Horns: Where provided, shall provide average ambient sound level of 15 dBA as listed in the NEPA 72.

5. Audible/Visual Combination Devices shall comply with all applicable requirements for both Programmable Electronic Sounders and Strobe Lights.

6. Bells shall be 10" diameter vibrating type located as shown on the Drawings; bells located outdoors shall be listed for use in wet locations. Bells shall have the following specifications: Voltage: Bells shall operate on 24 VDC nominal.

## 2.3 INITIATING DEVICES

A. Addressable Devices - General: All initiating devices shall be individually addressable. Addressable devices shall comply with the following requirements:

1. All addressable spot type and duct smoke detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature must be armed, and sensitivity set prior to acceptance of the system.

2. Address Setting: Addressable devices shall provide an address-setting means.

3. Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC) with minimum two (2) wires.

4. Operational Indications: Addressable smoke and heat detectors shall provide dual LEDs. LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. The flashing mode operation of the detector LEDs shall be optional through the system field program.

5. Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP, detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.

6. Spot-type detectors must be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails.

7. Device mounting Base: Unless otherwise specified all detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.

8. Test Means: The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition. Actual or synthetic smoke must be used during the 100% testing to assure smoke entry into the sensing chamber.

9. Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device.

B. Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light- scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

C. Thermal Detectors: Thermal Detectors shall be intelligent addressable devices rated at 135°F (58°C) and shall have a rate-of-rise element rated at 15° F. (9.4°C) per minute. It shall connect via minimum two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up

to 99 intelligent heat detectors may connect to one SLC circuit. Thermal detectors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.

1. Non-Rate of Rise Detectors: Provide thermal detectors with non-rate of rise thermal elements. Non-rate of rise detectors is indicated by NRR adjacent to the thermal detector symbol. Where used in elevator machine rooms or hoist ways, select temperature rating nominal 10 degrees F less than the adjacent fire sprinkler.

2. Specialized Element Temperature Ratings: Provide thermal detectors with specialized element temperature ratings. Specialized element temperatures are indicated by a temperature rating adjacent to the thermal detector symbol, e.g. 195°F.

D. Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate a velocity rated photoelectric detector. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When enough smoke is sensed, a supervisory or alarm signal shall be initiated at the FACP. Coordinate with owner for response appropriate for the location.

E. Addressable Pull Stations - General: Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except using a key. All pull stations shall be dual action, have a positive, visual indication of operation and utilize a key type reset. The Glass-break rods are not allowed. Mount pull station with operating mechanism between 42-inches and 48-inches above finished floor.

## 2.4 MISCELLANEOUS SYSTEM ITEMS

A. Addressable Dry Contact Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised zone (either Style D or Style B) of non-addressable Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuits. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.

1. Indication of Operation: An LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.

2. Supervision: Unless specifically noted otherwise on the drawings provide one monitor module for each sprinkler switch.

B. Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, Class B (Style D or B operation) of non-addressable 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuits. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings. Indication of Operation: Unless otherwise indicated on the Drawings. An LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.

C. Addressable Control Module: Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay. The control module shall provide address-setting means. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel. If the voltage being controlled is 120 VAC or greater, an isolating 24 VDC relay shall be used.

1. Configuration: The control module NAC circuit may be wired for (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires. Designer shall confirm the relay contacts are rated for the attached load.

2. Power Source: Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, 3rd party listed remote power supply. A/V power sources and connections are not shown on the Drawings.

D. Isolator Module: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC circuit. Modules must be readily accessible and clearly labeled.

1. Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC circuit. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module's operations shall be totally automatic.

2. The Isolator Modules shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated

E. Water Flow Switch: Flow switches shall be integral, mechanical, non-coded, non-accumulative retard type. Flow switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Flow switches shall be located a minimum of one (1) foot from a fitting that changes the direction of the flow and a minimum of three (3) feet from a valve as required per NFPA 13. Installation: Water Flow Switches shall be connected by the Division 16 (Electrical) Contractor but furnished and installed by the Division 23 (Mechanical) Contractor.

F. Sprinkler and Standpipe Valve Supervisory Switch: Supervisory switch mechanisms shall be contained in a weatherproof housings that shall provide a 3/4 inch tapped conduit entrance and shall incorporate the necessary facilities for attachment to the valves. Switch housing shall be finished in red baked enamel. Mounting: Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.

G. Serially Connected Remote Annunciator: Annunciator shall communicate with the fire alarm control panel via an EIA-485 communications circuit (four-wire) and shall individually annunciate all zones in the system. System zones shall be as indicated on the Drawings. Up to 10 annunciators may be connected to the EIA-485 communications circuit.

1. Annunciator Indicators: The annunciator shall provide a red Alarm LED per zone, and a yellow Trouble LED per zone. The annunciator shall also have an "ON-LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. Annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, and Global System Reset. All annunciator switches and indicators shall be software programmable.

2. LCD Alphanumeric Display Annunciator: The Alphanumeric Display Annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text. The LCD Annunciator shall display all alarms and trouble conditions in the system.

3. System Capacity: The system shall allow a minimum of four LCD annunciators. In addition to annunciation functions, each LCD annunciator shall be capable of the following software programmed system functions: Acknowledge, Signal Silence and Reset.

4. Connections: The annunciator shall connect to a two-wire EIA-485 interface. The two-wire connection shall be capable operation at distances of 6,000 feet. Provide interface to fiber optic cable systems and/or repeater units where such are indicated on the Drawings.

H. Remote Annunciator Indicator Lights (RAIL): RAILs shall be provided with a key type switch for testing of the annunciated device. In addition. RAILs shall have the following features: Voltage: RAILs shall operate on 24 VDC nominal.

I. Battery Power Supply (BPS) &/or Supplementary Notification Appliance Circuit (SNAC): These types of panels shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm upon a normal AC power failure. Battery cabinet shall be twice the size of the batteries it will contain. NAC circuits shall not exceed 75% of maximum current load allowed.

J. Surge Protection: The following protection against voltage transients and surges must be provided by the fire alarm equipment supplier, and installed by the electrical contractor:

1. On AC Input: A feed-through (not shunt-type) branch circuit transient suppressor such as Leviton 51020-WM-DIN, or Ditek DTK-120SRD 20 Amp or equivalent UL 1449 - Latest Edition Listed device.

2. On DC Circuits Extending Outside Building: At a point near entry to the building provide "pi"- type filter on each leg, consisting of a primary arrestor, series impedance, and a fast-acting secondary arrestor that clamps at 30v-40v.

Some acceptable models: Simplex 2081-9027, Simplex 2081-9028, Transtector TSP8601, Ditek DTK 2MHLP24BWB series, Citel America B280-24V, and Northern Technologies DLP-42.

Submit data on others to the engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable.

2.5 Wiring

A. Addressable circuit (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the circuit to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ acceptable if only FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.

1. Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.

2. In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.

PART 3 - EXECUTION

3.1 FIRE ALARM SYSTEM:

A. The fire alarm system shall be new and furnished with a warranty (parts & labor) of at least one year from the date of beneficial occupancy or final inspection by Owner. Equipment, initiating devices, and alarm appliances shall be arranged, and the annunciator zones shall be configured as described by the engineer’s written specifications.

B. All equipment supplied must be specifically listed for its intended use and shall be installed in accordance with the manufacture’s recommendations. The contractor shall consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Contractor shall refer to the Riser/Connection diagram for all specific system installation/termination/wiring data.

C. Do not locate addressable modules in unconditioned spaces.

D. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure. See Symbol sheet.

E. When programming the system, activate the automatic drift compensation feature for all spot type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the owner's representative or the AHJ. Alarm verification must

not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result.

F. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep.

G. Print a complete System Status and Programming Report after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector. This documentation shall be provided with the project O/M Manual.

## 3.2 FIRE ALARM CONTROL EQUIPMENT INSTALLATION

A. The fire alarm installer must meet the qualification requirements as described in the PART 1 of this specification.

B. The technician who makes final connections and programs the FACP is the "installer" even though most field connections to system devices and appliances are normally made by electrical contractor personnel. The responsibility for assuring a proper installation overall rests with this individual fire alarm system technician. In addition to doing the final hookups and activating the system, this individual is expected to check the field connections to assure all work is properly done. The absence of system "trouble" signals is not an adequate measure of the field wiring, which could have "T" taps, the wrong type of wire, improper terminations, ground (drain wire) issues, etc.

C. Notification Appliance Circuit booster power supplies must be individually monitored by the FACP and protected by a smoke detector per NFPA 72. They shall not be located above a ceiling, or in non- conditioned space. A 24vdc power circuit serving addressable control relays must also be monitored for integrity. All fire alarm power supplies shall have 120-volts surge suppressors.

D. Basic operating instructions shall be framed and permanently mounted at the FACP. (If the owner concurs, they may instead be affixed to the inside of the FACP's door.) In addition, the NFPA 72 "Record of Completion" must either be kept at the FACP, or its location shall be permanently indicated there by an engraved label. All System documentation shall be provided and housed in a Documentation Cabinet at the control panel or other approved location. (Per 2013 NFPA 72: 7.7.2)

E. Provide an engraved label on outside of the FACP door identifying its 120-vac power source, as follows: Panelboard location, panelboard identification, and branch circuit number. On inside of FACP door, indicate panelboard location.

F. Alarm notification appliances (audible and visible) are to comply with NFPA 72, the North Carolina Building Code, and ANSI 117 criteria for intensity and placement. The standard audible evacuation signal is the ANSI S3.41 three-pulse temporal pattern. All strobe lights installed in a single space must be synchronized. Devices can be mounted on the ceiling. Wall mounted devices shall be mounted with the entire lens between 80” minimum and 96” maximum off finished floor. See the NFPA 72 for additional alarm notification appliance requirements for special situations.

## 3.3 SURGE PROTECTION

A. For each AC power circuit that interfaces with fire alarm equipment, install an AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the suppressor in clipping fast rise time voltage transients.

B. On DC Circuits Extending Outside Building: Install the surge arrestor in a labeled enclosure near the point of entry to or exit from each building.

3.4 SIGNALING LINE CIRCUITS

A. One circuit per floor for signaling-line circuits.

3.5 AC POWER

A. Systems are to be provided with a separate and independent source of emergency power. Switching to emergency power during alarm shall not cause signal drop-out. Batteries must meet the appropriate NFPA capacity requirements, with a 25% safety factor. This requirement is in effect even if generator power is supplied to the Fire Alarm Control Panel.

B. The branch circuit breaker(s) supplying the system must be physically protected by a breaker handle lock-on device and each must be identified with a 1/4" permanent red dot applied to handle or exposed body area.

C. Provide an engraved label at each fire alarm system control unit, system sub-panel or data gathering panel, supplementary notification appliance (SNAC) panel, digital alarm communicator, etc. identifying the panel location, panel name, and breaker number for the 120VAC circuit. Example:

Electrical Rm 120 Panel EP1

Circuit 22

D. The fire alarm system shall monitor 120-VAC power to shunt trip breakers used in conjunction with fire suppression systems. Examples include a shunt trip used for cooking appliance power shut-off when the kitchen hood fire suppression system shoots, or primary elevator power shut-down upon heat detector activation in sprinkled hoist ways or machine rooms. Use an addressable monitor module to accomplish this supervisory function. Provide a breaker handle lock-on device on circuits used for shunt trip power.

3.6 CONDUIT AND WIRING

A. The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides.

B. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.

C. All fire alarm system wiring shall be in metal conduit or surface metal raceway. All fire alarm system raceway, couplers, and connectors must meet the performance and installation requirements of Electrical Specification Section "RACEWAYS".

1. Cable size and the requirement to maintain a Class "B" circuit on all Signaling Line Circuits.

2. PVC conduit is permitted to be used underground, in concrete, and in locations approved by the AHJ.

D. All conduits that penetrate outside walls from air-conditioned space must have internal sealing (duct- seal), to prevent condensation from infiltrating humid air.

E. All wiring shall be color coded. All the circuits in the system shall be wired with AWG 14, minimum, stranded copper, THHN/THWN conductor, installed in metallic conduits. Color Coded wires shall be in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

| | | |
|---|---|---|
| 1 | Initiating Circuits, General | Red (+)/White (-) |
| 2 | Initiating Circuits, Smoke Only | Violet (+)/Gray (-) |
| 3 | Signal Line Circuit cable | Red jacket with Red (+)/Black (-) |
| 4 | Alarm Indicating Appliance Circuits | Blue (+)/Black (-) |
| 5 | AHU Shutdown Circuits | Yellow (+)/Brown (-) |
| 6 | Door Control Circuits | Orange |
| 7 | Elevator Capture Circuits | Brown |

F. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated by a minimum of .25 inches per NEC, from other circuits, and the enclosure must have an appropriate warning label, to alert service personnel to the potential hazard. See NEC 760.136.

G. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

H. In multistory buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. If building layout requires the terminal cabinet to be above a drop ceiling, its location must be clearly and permanently

identified with a placard readable from floor. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

I. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten (10) megohms, as verified with an insulation tester.

J. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

## 3.7 ADDRESSABLE PULL STATIONS

A. Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except using a key. All pull stations shall be dual action, have a positive, visual indication of operation and utilize a key type reset. Glass-break rods are not allowed. Mount pull station with operating mechanism between 42-inches and 48-inches above finished floor.

## 3.8 NOTIFICATION DEVICES

A. Both audible and visible alarm signals shall be provided. Visible signals for fire alarm must be the strobe (flash discharge) type, with white or clear lens, and shall comply with current ADA requirements for intensity and placement.

B. Alarm notification appliance (NAC) circuits shall be NFPA 72 Class “A” or Class “B”. The load connected to each circuit must not exceed 80% of rated module output. The NAC voltage drop during alarm must not exceed 14% of the voltage measured across the batteries at that time. To achieve this, the design must consider wire size, length of circuit, device load, inherent voltage loss within the FACP power supply, etc. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly.

C. The location of all end of line devices shall be labeled on the device, with NAC panel number and NAC circuit number, and recorded on the “As-built” drawings. EOL shall not be located more than 12-feet above finished floor.

## 3.9 DETECTORS

A. The FACP and all other control equipment locations, including any transponders, sub-panels, and booster power supplies, must be protected by a spot type smoke detector located within 15 feet of the equipment (measured horizontally).

B. When installed in a room, detectors shall be oriented, so their alarm light is visible from the nearest door to the corridor, unless Remote Alarm Indicator Light (RAIL) equipped.

C. Spot-type smoke detectors shall secure the head to the base thru the built-in locking device. For detector mounted within 12 feet of the floor, activate this lock after the system has been inspected and given final acceptance.

D. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors must be replaced by the contractor at no additional cost to the Owner. Covers supplied with smoke detector heads do not provide protection against heavy construction dust, spray painting, etc., and must not be used for that purpose. They are suitable only during final, minor cleanup or touchup operations.

E. A detector installed where accidental damage or deliberate abuse is expected shall be provided with a guard that is listed for use with it and is acceptable to the AHJ.

F. Identification of individual detectors is required. Assign each a unique number as follows, in sequence starting at the FACP: (Addressable Circuit # -- Device #) Show on the as-built plans, and permanently mount on each detector's base so that it's readable standing on the floor below without having to remove the smoke detector. Exception: For detectors with housings (i.e., air duct, projected beam, air sampling, flame), apply the identification to a suitable location on exterior of their housing. Device labels may not be affixed to the device. Identification labels must be printed labels with black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.

G. Addressable Interface Modules (control and monitor modules)

1. Addressable interface modules (used to monitor all contact type initiating devices) must be in a conditioned space, unless they are tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed location.

2. One module may serve as many as 6 heat detectors, in a single space.

## 3.10 DUCT MOUNTED SMOKE DETECTORS

A. All air duct/plenum detectors must have a Remote Alarm Indicator Lamp with test switch (RAILS) installed in the nearest corridor or public area and identified by an engraved label affixed to the wall or ceiling. Duct smoke detectors are permitted to be installed only inside an air duct. It is not appropriate to mount them in front of a return air opening. Duct detectors shall also be installed in a manner that provides suitable, convenient access for required periodic cleaning and calibration. The numbers of detectors per duct shall be per NFPA 72 requirements based on the size of the air duct, air duct configuration, air speed, and duct manufacture’s installation requirements.

B. Each duct detector installation shall have a hinged or latched duct access panel, 12x12 inches minimum, for sampling tube inspection and cleaning. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal.

C. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long must be provided with far end support for stability.

1. The preferred method for providing support is to extend the intake tube through the far side of the duct, seal around the tube where it penetrates the duct wall and plug the end with a rubber stopper. This facilitates visual inspection and intake tube cleaning.

D. Duct smoke detector mounting position and air sampling tube orientation, are critical for proper operation. The Manufacturer's detailed installation instructions must be followed. The contractor shall mark the direction of air flow on the duct at each duct detector location.

E. Avoid the use of duct detectors on outside air intakes, as this can lead to nuisance alarms and troubles from moisture and dust.

F. A fire alarm panel output for a duct detector signal shall be as required by NC Building Codes and NFPA 72.

3.11 AIR HANDLER UNIT (AHU) SHUTDOWN

A. All shutdown relays must be directly controlled and monitored by the fire alarm system. The Building Automation System (BAS) shall not be used for life safety functions unless the BAS is supervised by the Fire Alarm System for off normal conditions. Relays should be wired fail safe. (BAS systems typically are not battery backed and typically do not supervise themselves or their wiring, for faults or communication loss between processors or CPU’s.)

3.12 REMOTE ALARM TRANSMISSION REQUIREMENTS

A. Digital Alarm Communicator Transmitter (DACT) for transmission of fire alarm, supervisory, and trouble signals to a Central Station, Remote Supervising Station, or Proprietary Supervising Station. DACT shall be dual transmission link type in accordance with NFPA 72. Transmission shall be cellular and Internet. Provide back-up power for signal transmission equipment as required in NFPA 72.’

B. The following signals shall be reported:

1. Fire Alarm

2. Fire Alarm System AC Power Trouble (only if 120vac interrupted for 1 to 3 hours)

C. The precedence of DACT / signals transmitted to the Supervising Station shall be as follows:

1. Fire Alarm

2. Supervisory Signal

3. Trouble Signal*

D. Do not confuse fire suppression system "supervisory" signals and fire alarm system "trouble" signals. These are completely different types of signals, annunciated and transmitted as separate and distinct events.

E. The Contractor must provide a type of DACT that is compatible with the owner's alarm receiving equipment, or the Supervising Station selected by the owner, as applicable. He must also program the PROM, connect each DACT to the data line provided to him, and verify proper signal receipt by the Supervising Station. The transmission means shall comply with NFPA 72.

3.13 FIRE ALARM SYSTEM INSTALLATION AND CONFIGURATION

A. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) must be supervised.

B. Graphic Chart must be mounted behind Plexiglas and secured to surface. Mounting shall be such that charts cannot be removed without the proper tools.

C. Floor Plans with Device Numbers: A copy of the floor plans shall be provided in the Documentation Cabinet at the control panel. A separate sheet shall be provided for each floor. Plans shall be reduced in size from engineering plans in order to fit on 11 x 14 sheets. All device addresses shall be clearly labeled on plans. Indicate locations of all cabinets, modules and end of line device.

D. Circuit 1 shall be assigned to the lowest level devices and circuit number shall increase with floor number. Device numbering starts in the same location on each floor and increase accordingly as circuit location increases.

## 3.14 SYSTEM DOCUMENTATION, TRAINING, AND MAINTENANCE

A. Maintenance: The manufacturer, or authorized distributor, must maintain software version (VER) records on the system installed. The system software shall be upgraded free of any charge if a new VER is released during the warranty period. For new VER to correct operating problems, free upgrade shall apply during the entire life of the system.

B. System Report In addition to the Shop Drawing submittal described elsewhere, the fire alarm system contractor shall provide the engineer two bound copies of the following technical information, for transmittal to the owner:

1. As-Built wiring diagram showing all circuit numbers and device addresses, plus terminal numbers where they connect to control equipment.

2. As-built wiring and conduit layout diagrams, including wire color code and/or label numbers, and showing all interconnections in the system.

3. Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, etc.

4. Manufacturer detailed maintenance requirement.

5. Technical literature on all control equipment, isolation modules, power supplies, batteries, detectors, manual stations, alarm/supervisory signal initiating devices, alarm notification appliances, relays, remote alarm transmission means, etc.

6. The as-built "calculations" sheet.

C. Electronic archive: Complete configuration data (site-specific programming) for the system must be stored on electronic media and archived by the fire alarm system manufacturer or authorized distributor. A USB drive or CD copy of this data shall be submitted to the engineer for transmission to the owner on the day the system is commissioned. A copy of this site-specific data base shall also be placed in the Documentation Cabinet.

D. The contractor shall provide the owner with one copy of the following:

1. All software required for the installed fire alarm system.

2. Complete documentation for all software for both the installed fire alarm system and for any interface PC software necessary for system functions as described above.

3. Framed floor plans mounted at the FACP: Plans shall show all system devices with the unique device identification numbers indicated adjacent to each device. The identification numbers shall match those represented in the as-built drawings and those reported at the FACP and the LCD annunciator. As-built room numbers shall match the signage in the building.

4. Interconnection cable where such is required to connect the fire alarm system to a PC; (if Owner does not have the needed PC to check the system).

E. The manufacturer's authorized representative must instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 8 hours on-site time will be allocated for this purpose and, for those facilities operating on a 24-hour basis (prisons, hospitals, etc.) one additional hour of instruction will be individually provided for the 2nd and 3rd shift. Two copies of a written, bound summary will be provided, for future reference.

1. Some facilities maintain their own systems and require more in-depth training. Check to verify needs and requirements.

2. Scheduling of training must be arranged to meet the Owner’s schedule. Additional training shall be available at a cost to be mutually agreed upon by the Owner and the Contractor.

3. Training shall be in the Owner’s provided classroom.

4. The training may not be waived, deleted or reduced in the number of hours required.

5. Training shall cover as minimum the following topics:

a. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.

b. Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to take any device out of service and return any device to service without need of Manufacturer’s approval or assistance.

c. Explanation of all control functions, including training to program and operate the system software.

d. Methods and means of troubleshooting and replacement of all field wiring devices.

e. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.

f. Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of training for the Owner's use in the future. *Training Quote: Provide a quote for one of the owner's Employees to receive factory certification level training on the system being installed. Quote is to include travel, room and food allowance.

3.15 SPARE PARTS:

A. The following spare parts shall be provided with the system. For multi-building projects, calculate quantities separately for each building that contains a dedicated fire alarm control panel. If FACP also serves auxiliary buildings (e.g., storage, boiler/chiller), calculate as if one building. Increase decimal quantities to the next higher whole number.

| | |
|---|---|
| Fuses (If Used) | 2 of each size in system |
| Manual Fire Alarm Boxes | 2% of installed quantity |
| Addressable Control Relays | 4% of installed quantity |
| Indoor Horns/Speakers with Strobes Lights | 4% of installed quantity |
| Indoor Strobe-only Notification Appliances | 4% of installed quantity |
| Monitor Modules (Addressable Interface) | 4% of installed quantity |
| Isolation Modules / Isolation Bases | 4% of installed quantity |
| Addressable, Electronic Heat Detectors | 4% of installed quantity |
| Spot-Type Smoke Detectors / Sounder Bases | 6% of installed quantity |

No spares are required for projected beam, air sampling, or duct smoke detectors

3.16 SYSTEM TESTING & CERTIFICATION

A. Upon completion of the installation the Contractor and the Manufacturer's authorized installer and designer together shall conduct a 100% performance test of every alarm initiating device for proper response. The system shall operate for 48 hours prior to start of test. The Contractor shall be present for the full 100% test. The person responsible for programming the system must be present.

B. The A/E and owner must be given 7 days' notice of the tests. All Audio-Visual Device Testing shall be scheduled with the owner.

C. 100% Test: The manufacturer or authorized distributor (by definition, "installer") must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report".

1. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc. The engineer shall witness these tests.

2. If AHU shutdown occurs for any alarm, then the matrix would indicate the specific control relay(s) for that function being commanded to operate for alarm from any initiating device. If a rolling steel fire door is to drop only upon water flow alarm from its sprinkler zone, or upon any two spot smoke detectors in adjacent spaces being simultaneously in alarm, the matrix would show the door's control relay activating upon alarm from the applicable water flow switch(es), or from any two smoke detectors in the selected spaces (AND gate)

3. The digital communicator shall be on-line and tested for proper communication to the receiving station.

4. All supervised circuits must also be tested to verify proper supervision. (Control circuits and remote annunciation lines are among those required to be supervised.)

5. All testing described above shall be repeated if subsequent software or wiring modifications are determined necessary to meet the requirements of the contract documents. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.

6. The contractor and engineer shall verify the voltage drop of each NAC circuit by testing and recording the voltage at the origin and at the EOL for each NAC circuit, under battery power only. Prior to conducting these tests, the contractor shall verify the candela settings of all strobes.

D. Test Documentation: The installer must fill out and submit the following documentation to the owner, through the engineer, prior to the AHJ's system acceptance inspection:

1. Written verification that this 100% system test was done with copy of print out generated during test.

2. The NFPA 72, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and to certify that: (a.) It was done per Code, and (b.) The Code required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) must sign this form. If a representative of the AHJ, owner, or engineer witnesses the tests, in whole or in part, they must also sign the form to signify that fact only (annotating the form as needed to clarify their limited role).

3. The System Status and Programming Report described in NFPA 72. This must be generated on the day of the system acceptance inspection and shall include the measured sensitivity of each smoke detector.

4. The purpose of doing Item (3) on the day of the inspection is to assure detector sensitivity has not been affected by construction dust. Prudent contractors will have taken measures to prevent detector contamination during construction and will also have had the system

do a detector sensitivity test and printout prior to the day of the inspection, to make certain all devices are properly programmed and operating within their limits.

5. After completion of the 100% system test and submission of documentation as described above the installer is to request the engineer to set up an inspection. The system must operate for at least two days prior to this inspection. The responding Fire Department shall be notified of this, for pre- fire planning purposes. On local government projects, local fire authorities may also want to participate in system acceptance inspections. However, for State-owned property they have no inspection jurisdiction and, if present, are only to observe.

3.17 PRE -FINAL INSPECTION:

At the Owner's request and after passing the Designer's pre-final inspection, the Contractor and Manufacturer's authorized installer will conduct system test in the presence of the Owner and the Designer.

3.18 FINAL INSPECTION:

The fire alarm system will be inspected, with portions of it functionally tested. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off premises supervising station. Operation of any smoke removal system will be checked as instructed by the AHJ. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The electrical contractor shall provide two-way radios, ladders, keys for resetting elevators and other equipment, and any other materials needed for testing the system, including a suitable smoke source.

A. The test will be conducted entirely by the Contractor. A copy of the final database software must be presented to the Owner before this test. The software shall be loaded from these disks into the system in the presence of the Owner. The review will then be conducted using this software. Any deficiencies shall be recorded and corrected. After the items have been corrected, the system shall be tested again.

   1. In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections.

   2. Test Report: Upon successful completion of the Inspection and after the correction of all deficiencies, the manufacturer's authorized representative shall issue a test report to the Engineer and Owner, detailing and certifying the test.

   3. System Acceptance: After successful completion of the Final Inspection and recommendation of the Engineer, the system will be accepted by the Owner. At this time the warranty period begins.

**END OF SECTION 283100**

THIS PAGE IS INTENTIONALLY LEFT BLANK

**SECTION 285000 – BI-DIRECTIONAL ANTENNA SYSTEM (BDA)**

PART 1 - GENERAL

1.1 Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies as required by the local AHJ (Authority Having Jurisdiction). System users shall receive and transmit radio signals from their portable radio units within the building. This shall be accomplished utilizing the following components:

A. Bi Directional Amplifiers (Signal Boosters)

B. Coaxial Cable

C. Antennas

D. Cable taps

E. Connectors

F. Power dividers

G. Other components and interconnecting circuitry as required

1.2 The system shall comply with the requirements of UL2524 In-building 2-Way Emergency Radio Communication Enhancement Systems, NFPA 72 2013 Edition, NFPA 1221 2016 Edition and 2018 NC Fire Code, as referenced.

1.3 The entire system shall meet the requirements of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).

1.4 The work in this section shall include the responsibility for all permit requirements with the AHJ. Where filings require engineer's signature, documents shall be submitted for his review and signature. This responsibility shall include furnishing of required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.

1.5 Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner.

1.6 Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included

1.7 The in-building emergency radio communication enhancement system shall use a UL2524, NFPA 72, NFPA 1221 and IFC 2018 compliant signal booster.

1.8 Submittals

A. Prior to performing any installation work. The fire alarm contractor shall submit complete Shop Drawings to the engineer for review. Upon approval by engineer, the contractor shall submit to AHJ for approval. The shop drawing shall clearly demonstrate compliance with the engineer's plans and specifications. Any non-compliant features must be fully described.

B. Shop drawing submittal shall include a copy of the valid FCC-issued general radio operators license who design the system.

1.9 Authority Having Jurisdiction (AHJ):

A. The AHJ for Code compliance is the Lenoir County Fire Marshal Office. No building permit is required for construction or renovation of facilities that are funded by the State of North Carolina and located on State-owned land. Contractor shall field coordinate site Inspections with AHJ.

PART 2 - PRODUCTS

2.1 The system specified shall be based upon UL2524, NFPA72, NFPA 1221 compliant signal boosters

2.2 The signal booster shall be a Class B Public Safety type as designated by the FCC or as required by the AHJ.

2.3 The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA 72, NFPA 1221 and 2018 NC Fire Code. The signal booster shall have both the primary and the secondary power supplies within a waterproof, type-4 approved enclosure.

2.4 All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.

2.5 The signal booster shall be pre-set by the equipment manufacturer for the frequencies specified by the AHJ. Field tuning of RF filters and duplexers is not allowed.

2.6 UHF and VHF signal boosters shall be band selective type with a maximum 3dB channel bandwidth of 200KHz (Fc +/- 100KHz) per band. Non-selective wide-band signal boosters shall not be accepted, unless required to cover multiple channels within the same band.

2.7 Signal Boosters shall have oscillation suppression circuitry to protect the public safety radio system in case of system malfunction or other causes. The oscillation suppression circuit shall not disable the system operation. Systems that automatically disable the signal booster upon oscillation detection shall not be allowed.

2.8 Signal Boosters shall have uplink noise suppression function to eliminate uplink noise while in standby (i.e. no radio transmission from within a building). Systems that produce any measurable level of uplink noise while in standby shall not be allowed.

2.9 Signal Booster gain shall be rated at minimum of 80dB and the gain shall be adjustable in a minimum of 30dB range. System gain shall be set and documented at the time of the final system test.

2.10 Maximum Propagation delay of the signal booster system shall be 14μs (microseconds) or as specified by AHJ.

2.11 The signal booster system shall include built-in automatic supervision of malfunctions of the signal booster and battery system as per NFPA 1221 NFPA 72 and 2018 NC Fire Code. Non-

OEM equipment add-ons and modifications to comply with this specification shall not be allowed.

2.12 A dedicated supervised monitoring panel shall be provided within the emergency command center next to the fire alarm panel / annunciator or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

A. Normal AC power

B. Signal booster trouble

C. Antenna Failure

D. Loss of normal AC power

E. Failure of battery charger

F. Low battery capacity

G. The communications link between the fire alarm system and the in-building 2-way emergency responder communication coverage system

H. Oscillation of active RF-emitting device(s)

2.13 External filters, duplexers, power supplies or other non-OEM additions or modifications of the original equipment shall not be allowed. All duplexers shall be built-in and FCC certified with the signal booster as an complete and fully integrated FCC-certified and UL-Listed unit.

2.14 All signal booster components shall be contained in a type-4 approved waterproof enclosure. All enclosures shall be painted red with external labeling as required by the AHJ.

PART 3 - EXECUTION

3.1 Design requirements

A. Contractor shall provide system design as stated in 2018 NC Fire Code section 510.4.

B. In-building emergency radio communication enhancement systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.

C. Critical Areas such as emergency command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.

D. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.

E. The In-building emergency radio communication enhancement systems must provide the following signal strengths:

1. Downlink - Minimum signal strength of -95 dBm throughout the coverage area.

2. Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.

3. OR As otherwise required by the AHJ

F. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.

G. An approved manufacturer or a qualified and approved vendor shall supply, test and determine locations of components which are required for proper operation as well as to supply, install, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.

H. Design shall include software-simulated radio propagation modeling with heat maps showing predicted signal coverage levels within the building. The design shall be done by the software certified personnel.

I. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.

J. The system design shall be based on the Public Safety Signal Boosters UL2524, NFPA 72, NFPA 1221, 2018 NC Fire Code and FCC certified to establish standards of quality for materials and performance. The naming of a specific manufacturer or a catalog number does not waiver any requirement or performance of individual components described in the specifications.

K. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.

L. Survivability from attack by fire shall meet requirements of NFPA 72, NFPA 1221, 2018 NC Fire Code or as required by the local jurisdiction.

M. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.

N. Antenna isolation shall be maintained between the donor antenna and all inside antennas (Distributed Antenna System - DAS) to a minimum of 20dB under all operating conditions

3.2 Approval prior to installation. Amplification system capable of operating on frequencies licensed to any public safety agency by the FCC shall not be installed without prior coordination and approval of the fire code official.

3.3 Installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code NFPA-70, NFPA-72, NFPA 1221, 2018 NC Fire Code or as required by the local AHJ.

3.4 At least 2 independent and reliable power supplies shall be provided as specified in NFPA 72, NFPA 1221 and 2018 NC Fire Code.

3.5 The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA-70 National Electrical Code, NFPA 72 and NFPA 1221 2016 edition

The signal booster shall be equipped with a secondary source of power. The secondary source of power shall be a battery system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall power on automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a waterproof Type-4 approved enclosure. Batteries shall be enclosed in a separate, vented Type-3R approved enclosure. External UPS (Uninterruptable Power Supplies) are not acceptable.

3.6 RF Coaxial Cable shall be a listed, CMP plenum. Non-plenum cable can be used when installed in a metallic raceway. The cable classification shall be clearly marked on the outer surface of the cable regular intervals.

3.7 Acceptance and Test Procedures

A. The acceptance test procedure shall be as stated in 2018 NC Fire Code section 510.5.3 or as directed by the AHJ.

B. Acceptance testing for an in-building radio system is required upon completion of installation.

C. The coverage testing shall be done in accordance with NFPA 72, NFPA 1221, 2018 NC Fire Code and as required by the local AHJ

D. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.

E. All test records along with system diagrams, design, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project, and as required by the AHJ.

**END OF SECTION 285000**

THIS PAGE IS INTENTIONALLY LEFT BLANK

**SECTION 285500 – RF SURVEY FOR EMERGENCY RESPONDER RADIO ANTENNA/REPEATER SYSTEM**

PART 1 - GENERAL

1.1 SUMMARY

A. The purpose of this specification is to establish the requirements and standards for initial survey for public safety radio signal strength per NFPA and 2018 NC Fire Code.

B. Survey should be performed after the building is substantially completed, and prior to start of installation of electrical wiring.

C. Conduct a survey using a RF Spectrum Analyzer, a calibrated, system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength of Emergency Responder Radio Signal into the building and determine if amplification of the signal is required. Both inbound and outbound signal strength shall be determined, measured, calculated and documented as required by code.

1.2 SURVEY CRITERIA IF REQUIRED

A. The required Public Safety Radio Signal Level inside the Owner's facility must be determined per code, ordinance, or AHJ

B. Survey shall be performed by an FCC licensed technician holding a current GROL license. Honeywell Fire have distributors that meet these requirements.

1.3 REGULATIONS

A. Codes, regulations and standards referenced in the Section are:

1. NFPA 1 – The National Fire Code (including Annex O from 2009)

2. NFPA 70, 2020 Edition – The National Electrical Code

3. 2018 NC Fire Code, Section 510- Emergency Responder Radio Coverage

4. NFPA 101, Life Safety Code, the Ohio Building Code, and Local Code and Building Authority requirements.

5. NFPA 72, 2013 Edition - National Fire Alarm Code

6. FCC 47 CFR Private Land Mobile Radio, Part 90.219 Services-Use of Signal Boosters

7. 2018 NC Building and Fire Codes

8. ADA "Americans with Disabilities Act"

9. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"

10. FCC Rules Part 22, Part 90 and Part 101

11. NFPA 1221 2016 Edition

12. UL 2524

1.4 DEFINITIONS

A. Bi-Directional Amplifier BDA: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.

B. Emergency Responder Radio Coverage System: A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services, or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.

C. FCC: Federal Communications Commission

D. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

E. Safety/First Responder: Public Safety or First Responder agencies that are charged with the responsibility of responding to emergency situations. These include, but are not limited to law enforcement departments, fire departments, and emergency medical companies.

F. RSSI: Received signal strength indicator RSSI is a measurement of the power present in a received radio signal.

G. BER: Bit Error Rate is the number of bit errors per unit time

H. GROL- FCC General Radio Operators License

I. ERRCES- Emergency Responder Radio Coverage Enhancement System

J. DAS-Distributed Antenna System

PART 2 - EXECUTION

2.1 TESTING PROCEDURES

A. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the. -95dBm nominal signal at 100%.

B. Spectrum Analyzer or Calibrated Handheld Radio shall be used as basis for signal measurements or other method as approved by AHJ.

C. Testing should be based on a minimum of 20 grid locations per floor OR maximum of 1600 SQ ft. areas if the floor exceeds 32,000 Sq. Ft. Also, testing should include all critical areas per NFPA. See A.2 of this specification and NFPA 72 2013 or NFPA 1221 2016. OR per any method determined by the AHJ, local code or ordinance.

D. A minimum signal strength of -95 dBm shall be provided throughout the coverage area for both uplink and downlink by the Local Fire Department.

1. RSSI measurement only

2.2 SURVEY SUBMITTALS

A. Submit testing data for each level of the building.

1. An RF measurement drawing of each floor of the building which indicates relative RF field strength for each frequency band of interest must be submitted to the AHJ.

2. The drawing should indicate clearly the areas that have passed or failed based on the above parameters.

END OF SECTION 285500

THIS PAGE IS INTENTIONALLY LEFT BLANK

The Specification Sections applying to the Site Work for the NEW PITT COUNTY ADMINISTRATION BUILDING in Greenville, North Carolina are as follows:

TABLE OF CONTENTS


| DIVISION 31 – EARTHWORK | Page Number |
|---|---|
| Section 312000 – Earth Moving | 312000 1 – 9 |
| Section 312200 – Trenching, Backfilling and Compaction | 312200 1 – 11 |
| **DIVISION 32 – EXTERIOR IMPROVEMENTS** | |
| Section 321216 – Asphalt Paving | 321216 1 – 4 |
| Section 321313 – Concrete Paving | 321313 1 – 6 |
| Section 329100 – Erosion and Pollution Control | 329100 1 – 5 |
| Section 329200 – Turf and Grasses | 329200 1 – 7 |
| **DIVISION 33 – UTILITIES** | |
| Section 330500 – Common Work Results for Utilities | 330500 1 – 6 |
| Section 332110 – Water Pipe and Pipe Fittings | 332110 1 – 7 |
| Section 332120 – Water Valves | 332120 1 – 5 |
| Section 332130 – Water Pipe Accessories | 332130 1 – 3 |
| Section 332140 _ Water Services | 332140 1 –5 |
| Section 333100 – Gravity Sanitary Sewer System | 333100 1 – 4 |
| Section 334100 – Storm Sewer System | 334100 1 – 5 |



Rivers & Associates, Inc.
Since 1918
ENGINEERS, PLANNERS, SURVEYORS & LANDSCAPE ARCHITECTS

107 E. Second Street, Greenville, NC 27858
P.O. Box 929, Greenville, NC 27835
Phone: 252-752-4135
Fax: 252-752-3974
NCBELS License No. F-0334

**SECTION 330500 – COMMON WORK RESULTS FOR UTILITIES**

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division 1 - Specification sections apply to work of this section. Work shall be done in accordance with GUC Design Manual. All references to Owner and Engineer shall imply Greenville Utilities Commission and their representatives.

DESCRIPTION OF WORK:

Work under this section includes all material certificates; shop drawings; disinfection of all wetted parts of the total system; and field testing of all pipe, pipe fittings, piping specials, and valves in all sections of Division 33 necessary to complete and make serviceable the water supply system.

Related Work Specified Elsewhere:

Water Pipe and Pipe Fittings - Section 332110
Water Pipe Accessories - Section 332130
Water Valves - Section 332120
Water Services – Section 332140

QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards
North Carolina Division of Health Services: All rules and regulations
Greenville Utilities Commission Design Manual

PART 2 - PRODUCTS - None

PART 3 - EXECUTION

DISINFECTION OF NEW WATER SYSTEMS:

Before being placed into service, and before certification of completion by the Engineer, all new water systems, or extensions to existing systems or valved section of such extensions, or any

replacement in the existing water system, or any exposed section of the existing system shall be disinfected as follows:

DISINFECTION OF NEW SYSTEMS

(a) All interior surfaces of new potable water supply systems, including wells, filters, storage tanks and distribution lines shall be thoroughly disinfected by means of hypochlorite or chlorine solutions, after which bacteriological test samples shall be collected.

(b) After disinfection the water supply shall not be placed into service until bacteriological test results of representative water samples analyzed in an approved laboratory are found to be satisfactory.

DISINFECTION OF STORAGE TANKS AND DISTRIBUTION SYSTEMS

(a) Water distribution systems, including storage tanks and water mains, after flushing to remove sediment and other foreign matter, and after testing for leaks, shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of at least 100 milligrams per liter (or ppm) in the water throughout the distribution system, including all water mains and storage tanks.

(b) The chlorine solution shall remain in contact with interior surfaces of the water system for a period of 24 hours. Then the water system shall be flushed with fresh water from an approved water source until the chlorine solution is dispelled.

(c) Representative samples of the water shall then be collected. If bacteriological tests of the samples indicate that the water quality is satisfactory, the water mains and storage tanks may be placed in service.

(d) In unusual situations where large volume tanks are involved and where there is not sufficient water available to fill the tank or there is not available a suitable drainage area for the chlorinated water, an alternate disinfection procedure for tanks may be proposed. Such proposal must be submitted in writing completely describing the proposed disinfection procedure and substantiating the need for an alternate procedure in the particular circumstance. Such alternate procedure must be approved before being implemented. The conclusion of the department shall be final."

The Contractor shall be required to make arrangements for having tests conducted. All expenses incurred in making tests shall be borne by the Contractor and should be included in his bid.

TESTING NEW WATER LINES:

The following test sequence shall be included in all water system extension specifications unless otherwise directed by the Engineer.

(1) Perform pretest inspection.
(2) Clean the main.
(3) Perform the hydrostatic tests.
(4) Apply the proper dosage of chlorine.
(5) Allow chlorine solution to remain in the water main a minimum of 24 hours.
(6) Flush the main.
(7) Assist the Owner in taking bacteriological samples.

Pretest Inspection:

Prior to the commencement of hydrostatic testing and chlorination, the Engineer shall be contacted to request scheduling of inspection and testing. A Engineer's Representative shall visually inspect the installation prior to testing to insure that all fire hydrants, valves and other appurtenances are properly located, operable, and installed at the proper grade. All defects disclosed by the inspection shall be corrected prior to testing.

Cleaning Of The Main:

Cleaning of Water Mains 4" and Smaller in Diameter: Mains smaller than 4" in diameter shall be cleaned by flushing. Flushing velocity shall be adequate to remove all debris and other undesirable material and a minimum of 2-1/2 feet per second.

Cleaning of Water Mains 4" and Larger in Diameter: Mains shall be flushed only in the presence of Owner's Representative. No valves or hydrants shall be operated without the express permission of the Owner.

Cleaning shall be accomplished by passing through the pipe a polyethylene "pig" of the appropriate size and density (as manufactured by Poly-Pig or approved equal). Pig(s) shall be furnished by the Contractor. The procedure shall be as follows:

A. The Contractor shall prepare the main for the installation and removal of pig(s) as required:

1. In general, this will consist of furnishing all equipment, material, and labor to satisfactorily install and remove the pig(s).
2. Prior to scheduling a preconstruction conference, the Contractor shall submit a "pigging" plan to the Engineer for approval.
3. Where expulsion of the pig is required through a dead end main, Contractor shall prevent the backflow of purged water into the main after expulsion of the pig. For pipe 12" or less in diameter, purged water can be prevented from reentering into the pipe by the temporary installation of pipe and fittings as required to provide a riser with an above ground discharge. On larger pipe, additional excavation of the trench may serve the same purpose.
4. After expulsion of the pig, completion of flushing, and at the direction of the Engineer, the Contractor shall complete work at openings by plugging, blocking, backfilling and completion of all appurtenant work necessary to secure the system.

B. Under the supervision of the Inspector, pig(s) shall be propelled via water pressure through the main(s) from the point of insertion to the point of expulsion. Where mains are in the form of a loop, the Contractor shall "pig" the complete system.

C. As an alternate to "pigging", dead end pipe of less than 100 feet in length which are difficult to "pig" may be cleaned by flushing. Flushing shall be accomplished in the same manner as that required for pipes less than four inches in diameter.

Hydrostatic Test:

Unless otherwise permitted, testing shall be performed between each main line valve in accordance with AWWA C600. The Owner will, except when certain circumstances dictate otherwise, permit the lengths of test sections to be a maximum of 1500 feet in subdivisions or other areas where the new main has closely spaced valves. Testing shall be done only in the presence of Owner's Representative unless directed otherwise. Testing shall be performed using a suitable pump and an accurate gauge graduated in 1.0 psi increments. The section of the main to be tested shall be subjected to a test pressure of 150 psi for a period of two (2) hours. The leakage of the test section shall be accurately determined and compared to the schedule shown below. All visible leaks shall be repaired regardless of the amount of leakage.

| PIPE SIZE (inches) | ALLOWABLE LEAKAGE (Gallons per hour per 1000 feet of pipe) |
|---|---|
| 2 | 0.16 |
| 4 | 0.33 |
| 6 | 0.50 |
| 8 | 0.66 |
| 10 | 0.83 |
| 12 | 0.99 |
| 14 | 1.29 |
| 16 | 1.47 |
| 18 | 1.66 |
| 20 | 1.84 |

If the leakage is greater than the allowable leakage as given by the above table, the Contractor shall replace any defective materials and perform all necessary work to insure that the installation is acceptable and a retest shall be performed subsequent to any repair work performed. Remedial repair work and retesting shall be repeated until the leakage occurring during the test period is less than or equal to the allowable leakage.

Chlorination:

Chlorination shall be performed only in the presence of Owner's Representative and shall be performed only after the line is complete and has tested satisfactorily for leakage.

Chlorination taps will be made within five (5) pipe diameters of the water main control valve at the upstream end of the line and at all extremities of the line.

Sufficient chlorine solution shall be applied to bring the concentration within the main to a minimum of 100 ppm free chlorine residual.

The chlorine solution shall be introduced to the main at a constant rate while regulating the flow of water through the main being chlorinated such that the required concentration of chlorine is achieved throughout.

All valves within the section of main being chlorinated shall be operated once during the contact period.

The chlorine solution shall remain in the lines for no less than twenty-four (24) hours, longer if so directed by the Engineer.

Services shall be chlorinated at the same time and by the same method utilized for the main. Extreme care shall be taken to prevent contamination of existing water mains during the test period. If an existing main is contaminated, the section of main subjected to the possible contamination shall be flushed and chlorinated in accordance with the requirements for new mains.

The Engineer will advise the Contractor when a suitable period of time has elapsed for chlorine contact. The main shall be flushed thereafter in the presence and under the direction of the Owner's Representative. The flushing of the main shall be considered complete when the chlorine concentration with the main is less than or equal to the lesser of the following values:

One (1) part per million (ppm) free chlorine.

The free chlorine concentration within the existing main to which the extension has been connected.

The Contractor shall be responsible for insuring that high-strength chlorine solution is contained on-site and not allowed to make its way to any watercourse, stream, creek, lake, or other body of water.

Bacteriological Testing:

After completion of chlorination and flushing, the Contractor shall assist the Owner as necessary in obtaining sufficient bacteriological samples for complete testing.

The Owner shall determine the location of samples and the number of samples necessary to provide a test group which is representative of the section of main being tested.

A failure of any sample of a test group shall constitute failure of the entire test group from which the sample was taken. Such failure shall require two (2) successive passing test groups to substantiate that the main has been satisfactorily chlorinated. The second of the two successive test groups of samples will not be collected before nor unless the first group has passed.

The Contractor may, at his option, rechlorinate and retest the section of water main upon failure of the test group.

If two (2) successive bacteriological test groups fail, the section of main from which the group is taken shall be rechlorinated and retested until the main is shown to be properly chlorinated in accordance with the above requirements.

**END OF SECTION 330500**

**SECTION 332110 – WATER PIPE AND PIPE FITTINGS**

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of work under this item includes providing and installing all pipe and pipe fittings as shown on the drawings and described herein necessary to make complete and serviceable the finished water main.

Related Work Specified Elsewhere:

Trenching, Backfilling and Compaction: Section 312200
Common Work Results for Utilities: Section 330500
Water Valves: Section 332120

QUALITY ASSURANCE:

General: Class numbers or pressure rating shall be clearly marked on the pipe and fittings at the factory. The materials used for the construction of water mains and all accessories and appurtenances thereof shall be new, free of defects in product and workmanship and of the highest quality available in the industry. Materials not specified but deemed equal to those specified may be approved for use provided the documentation and samples necessary for approval are provided to the Engineer thirty (30) days prior to the ordering of said materials. WRITTEN APPROVAL must be issued by the Engineer before such material may be used in construction. Current specifications (latest revisions) shall apply in all cases where materials are described by reference to published standards such as ASTM, AWWA, ANSI., etc.

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards
North Carolina Division of Environmental Management: All rules and regulations
North Carolina Division of Health Services: All rules and regulations.

SUBMITTALS:

Material Certificates: Provide notarized materials certificates signed by the material manufacturer. Certify that each material item complies with the specified requirements, and was purchased for this project.

Shop Drawings: Submit shop drawings on all flanged fittings.

PART 2 - PRODUCTS

Water Main and Fittings: Water mains shall be constructed of polyvinyl chloride (PVC) or ductile iron pipe (DIP) at the option of the Contractor, except in instances where the plans or the Engineer specifically requires a particular pipe material be utilized for an installation. All plastic pipe shall bear the seal of the National Sanitation Foundation.

2" & 3" PVC Pipe: PVC water main and services shall be PVC Class 200 SDR 21 conforming to the latest revisions of ASTM D 1784 and ASTM D2241 with "push-on" joints. Pipe shall be furnished in nominal twenty foot (20') lengths. Fittings for service pipe shall be schedule 80 PVC with solvent weld joints.

PVC Water Mains 4 Inches and Larger in Diameter: PVC water main 4 inches and larger shall be manufactured in accordance with AWWA Standard C900. The pipe shall have push-on type joints with elastomeric gaskets. The pipe shall be pressure rated at 150 psi with a dimension ratio of 18 for both bell and pipe thickness. Pipe shall be furnished in nominal twenty foot (20') lengths.

Ductile Iron Pipe: Ductile iron pipe for water mains shall be manufactured in conformance with AWWA C151 and shall be cement- mortar lined with an asphaltic coating in accordance with AWWA C104. The exterior of the pipe shall be bituminous coated in accordance with AWWA C-151. The minimum thickness Class of pipe shall be Class 50. Pipe shall be furnished in nominal 18 to 20 foot lengths. Pipe joints for ductile iron pipe shall be "push-on" unless the additional pipe deflection allowed by mechanical joints is necessary or other considerations dictate the use of mechanical joints. The joints for ductile iron pipe shall conform to AWWA Standard C111 revision (ANSI A21.11).

Polyethylene Encasement: Polyethylene encasement shall be applied to all underground ductile iron pipe and fitting installations. Materials and installation procedures shall be in accordance with ANSI/AWWA C-105/A21.5-88.

Fittings: Tees, elbows and other fittings for PVC C-900 pipe and ductile iron pipe shall be of ductile iron unless otherwise permitted or required by the Owner. Standard dimension fittings or compact fittings may be used in accordance with the requirements of this Section.
The interior of all fittings shall be cement mortar lined with an asphaltic coating in accordance with AWWA Standard C-104 (ANSI 21.4). The exterior of all fittings shall have a one (1) mil bituminous coating in accordance with AWWA Standard C-110 (ANSI A21.10).

Compact fittings shall be ductile iron with either push-on or mechanical joints in accordance with ANSI/AWWA C153/A21.53-84. Cement lining with an asphaltic coating shall be provided in accordance with ANSI/AWWA C104/A21.4.

"Push-on" joints shall be used unless the additional deflection allowed by mechanical joints or other considerations dictate the use of mechanical joints.

Standard dimension fittings for PVC C-900 pipe and ductile iron pipe shall be of ductile iron with "push-on" joints unless the additional pipe deflection allowed by mechanical joints or other considerations dictate the use of mechanical joints. The fittings shall comply with all requirements of AWWA Standard C-110 (ANSI A21.10) and shall be designed for a minimum working pressure of 150 psi plus 100 psi surge pressure.

Restraint devices for use on ductile iron and C-900 PVC "push-on" joints: shall be constructed of high strength ductile iron, ASTM A536, Grade 65-45-12 and shall incorporate machined serrations on the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength, low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Block Buster Series 1390-C, Star Pipe Products Allgrip series 3600 and Pipe Restrainers Series 1200S, or approved equal.

Restraint devices for use on mechanical joint to C-900 PVC: shall be constructed of high strength ductile iron, conforming to the requirements of ASTM A536, Grade 65-45-12, and shall incorporate machined serrations on the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Series 1500, Star Pipe Products, Allgrip Series 3600, Romac Industries, Inc GripRing or approved equal.

Restraint devices for use on mechanical joint ductile iron: shall be constructed of high strength ductile iron, conforming to the requirements of ASTM A536, Grade 65-45-12, and shall incorporate machined serrations on the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Series 1300-C, Star Pipe Products, Allgrip Series 3600, Romac Industries, Inc. GripRing or approved equal.

JOINTS AND JOINTING MATERIALS FOR LARGE PIPE:

General: Where the joint type is not indicated on the drawings, either push-on or mechanical joints shall be furnished for buried pipe.

Ductile Iron:

Push-on joints shall conform to applicable requirements of AWWA C111 (ANSI A21.11). Gaskets and lubricants for pipe fittings shall conform to applicable requirements of AWWA C111 (ANSI A21.11).

Mechanical joints, including pipe ends, glands, bolts and nuts, and gaskets, shall conform to applicable requirements of AWWA C111 (ANSI A21.11).

Pipe capable of joint deflection of up to 5 degrees per joint shall be provided.

## PART 3 - EXECUTION

### GENERAL:

Adherence to Standards and Instructions: All pipe, of whatever material, shall be transported, handled, stored, and installed in keeping with applicable AWWA, ASTM etc. standards and manufacturer's instructions for the particular pipe material involved. For PVC piping system, the latest edition of the CHEMTROL PLASTIC PIPING HANDBOOK as published by Celanese Piping Systems, Inc., Louisville, Kentucky, shall be the project reference manual and instructions contained therein shall be followed.

Responsibility for Materials: During loading, transportation, unloading and storage, every precaution shall be taken to prevent injury to pipe, fittings and accessories and to keep them from dirt and foreign matter at all times. Particular care shall be taken to prevent damage to pipe and fitting linings and coatings. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate specifications.

Provide caps or plugs for open ends of pipe lines and equipment during installation to keep dirt and other foreign matter out of pipe and equipment.

Expansion: All piping mains, branches, and runouts shall be so installed as to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Stresses shall be within allowable limits of ASA Code B31.1 for pressure piping.

### EXTERIOR:

General Pipe Laying: All pipe, special castings, valves, fittings, and the bells and/or spigots of same shall be thoroughly cleaned of all earth or other foreign matter before being fitted together. The spigot end shall be adjusted in the bell of the pipe, special casting or valve to allow for uniform gasket space, and the pipe shall be completely forced home and held there.

Prior to being lowered into the trench, each joint of pipe shall be carefully given a final inspection to see that each is clean, sound, and free of defects. Damaged sections shall be repaired to the satisfaction of the Engineer or removed from the Site.

Pipe shall be laid accurately to the line and grade as designated on the job plans. Bell holes shall be excavated for each joint to assure bedding supports the barrel of the pipe and to facilitate making a perfect joint.

Pipe shall be laid in perfect alignment between turns. No abrupt changes, either in grade or alignment, will be acceptable. At such locations where alignment changes are indicated on the plans, fittings and adjacent pipe shall be self restrained by harnesses or special fittings or external blocking. Do not bend or deflect pipe more than recommended by manufacturer.

Cross above or below existing pipe a minimum of 12" unless otherwise directed by the Engineer.

During construction of the line work the lines shall be kept free from debris. Trenches shall be kept free from water; and when work is not in progress, all open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substances will enter the pipe or fittings. At the end of each day's work, the pipe shall be inspected to insure that dirt, water, and other materials have not entered the pipe.

PIPING JOINTS AND CONNECTIONS:

Mechanical Joints: Make up with Style A plain rubber molded gaskets, unless otherwise specified. Preparatory to making pipe joints, all surfaces of the portion of the pipe to be jointed or of the factory-made jointing materials shall be clean and dry. Gaskets, whether for the mechanical joint type or push joint type, shall be clean, flexible, and, where lubrication is required, be lubricated with a lubricant recommended by the manufacturer. Provide special joints capable of up to 5 degrees deflection per joint where shown on the drawings. Do not deflect or bend pipe more than recommended by manufacturer.

CLEANING:

Piping systems shall be thoroughly cleaned as follows:
Flush all pipe lines with clean water and perform visual inspection where possible to achieve a clean piping system clear of all debris, rust and dirt.

THRUST RESTRAINT:

All plugs, caps, tees and bends deflecting 11-1/4 degrees or more shall be provided with reaction blocking of 2,500 psi concrete or suitable metal harness to prevent movement. Blocking shall be placed between solid earth and the fitting to be anchored. The blocking shall be placed such that pipe and fitting joints are accessible for repair and/or future connections. Where space limitations will not permit installation of concrete blocking where necessary to insure accessibility, where shown on the drawings, or if the Contractor so elects, pipe and fittings may be self restrained in addition to or in lieu of concrete blocking. Pipe shall be designed to carry additional stresses of thrust restraint. Details pertinent to such self-restraining harness, tie rods, special pipe, etc., including design criteria and computations, must be submitted to the Engineer for evaluation prior to incorporating such devices into the work. Systems based on metal to metal friction, such as retainer glands, will not be allowed for pressures above 100 psi.

Reaction Backing: The area of bearing of the concrete backing on the earth in each instance shall be at least equal to that shown in the table below. Minimum bearing area against undisturbed sand trench wall in square feet. Details of placement are shown in the drawing.

Areas shown are for 150 psi test pressure. If test pressure is other than 150 psi, adjust area of reaction backing in direct proportion.

| Pipe Size | Tees Plugs | Hydrant 90 Degree Els | Wyes 45 Degree Els | Wyes 22-1/2 Degree Els | Wyes 11-1/4 Degree Els |
|---|---|---|---|---|---|
| 4" | 1 | 2 | 1 | 1 | 1 |
| 6" | 3 | 3 | 2 | 1 | 1 |
| 8" | 4 | 6 | 3 | 2 | 1 |
| 10" | 7 | 9 | 5 | 3 | 2 |
| 12" | 9 | 11 | 6 | 3 | 2 |
| 14" | 11 | 15 | 8 | 5 | 3 |
| 16" | 13 | 20 | 10 | 6 | 3 |

Areas based on sand; for other soil conditions revise areas as indicated:
Cemented Sand or Hardpan - multiply above by 0.5
Gravel - multiply above by 0.7
Hard Dry Clay - multiply above by 0.7
Soft Clay - multiply above by 2.0

Muck: Secure all fittings with approved harness or tie rod clamps, with concrete reaction backing the same as listed for sand conditions.

TESTING PIPING SYSTEMS:

See Section 330500

DISINFECTION OF PIPING SYSTEMS:

See Section 330500

**END OF SECTION 332110**

**SECTION 332120 – WATER VALVES**

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of work covering valves and gates includes furnishing, installing, and making operational all valves and gates as indicated on the drawings and specified herein.

Related Work Specified Elsewhere:

Common Work Results for Utilities: Section 330500
Water Pipe and Pipe Fittings: Section 332110
Water Pipe Accessories: Section 332130

QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards

SUBMITTALS:

Shop Drawings: Submit shop drawings for all valves, valve boxes, tapping sleeves, and special items.

PART 2 - PRODUCTS

2" Ball Valve: Ball valves for two-inch services shall be bronze body with tee head. The turn required to travel from fully closed to fully open position shall be 90 degrees. Ball valves shall incorporate a check allowing a maximum turn of 90°. Ball valves shall be Hayes 4300, Ford B11-777, A Y McDonald 6101, Mueller B 20283, or approved equal.

Gate Valves (3" and Larger): Gate valves shall conform to the requirements of the latest revision of AWWA Specification C-509/C-515 for resilient seated gate valves. The valve body shall be ASTM A-126 Class B cast iron or ductile iron and shall conform to ASTM A395 or ASTM A536. In addition, ductile iron shall contain no more than 0.08 percent phosphorous. All interior valve parts and surfaces shall be of corrosion resistant materials or have an epoxy coating sufficient to prevent corrosion. Such coating shall be recognized by the AWWA for potable water use. Exterior valve parts and surfaces shall be epoxy coated or have the Standard AWWA coating. The valves shall open counterclockwise and have non-rising stem operation with 2-inch square operating nuts. The maximum number of turns required to fully open or close the valve shall equal three times the pipe diameter plus two. The stem shall be of corrosion resistant material and have "O" ring seals. Valves shall provide zero leakage at a working pressure of 200 psi in either direction of line flow. Valves shall have flange connections conforming to ANSI B16.1 Class 125 or mechanical joints conforming to AWWA C-111.

Valves shall be manufactured by Clow, American Flow Control, or Mueller.

Tapping Valves: Tapping valves shall conform to the requirements of the latest revision of AWWA Specification C-509 for resilient seated gate valves. The valve body shall be ASTM A-126 Class B cast iron. All internal valve parts and surfaces shall be of corrosion resistant materials or have an epoxy coating sufficient to prevent corrosion. Such coating shall be recognized by the AWWA for potable water use. Exterior valve parts and surfaces shall be epoxy coated or have the Standard AWWA coating. The valves shall open counterclockwise and have non-rising stem operation with a two inch square operating nut. The maximum number of turns required to fully open or close the valve shall equal three times the pipe diameter plus two. The stem shall be of corrosion resistant material and have O-ring seals. Valves shall provide zero leakage at a working pressure of 200 psi in either direction of line flow. Valves shall have a flange connection conforming to ANSI B16.1 Class 125 and a mechanical joint conforming to AWWA C-111. Valves shall be manufactured by Mueller, Clow or American Flow Control. Tapping valves shall be installed and pressure tested prior to tapping the water line.

Valve Boxes (valves 2” through 10”): Valve boxes shall be of cast iron suitable for H-20 loading. The manufacturer’s name and part number shall be cast into each component of the box. The box shall be of the telescoping (slip) type consisting of a base section, center extensions as necessary, and a top section with a cover marked "WATER". Sections shall be selected such that a minimum of four inches (4") of future adjustment (upward and downward) will be possible without section removal or replacement and without the use of adapters. Valve boxes and extensions shall be either of the following:

Charlotte Pipe and Foundry: UTL-274 (valve boxes) and UTL-28l (extensions).

Tyler Pipe: 6855 Series (valve box and extensions). Lid shall be 5 1/4” Drop Lid having a minimum of 1 1/2” deep skirt.

Valve boxes shall be installed in accordance with the Standard Details.

Indicator Post: Cast iron indicator posts shall be provided in the locations shown on the drawings. Posts shall have two large window openings that are fitted with heavy clear plexiglass. Aluminum target plates, with the words OPEN and CLOSED cast in large, easy-to-read, raised letters shall be located behind each window in such a position that the appropriate word appears as the valve is operated. Stem, indicators, and all working parts shall be fully protected from moisture and weather damage by complete enclosure. The indicator posts shall be Clow F-5760, Americal Flow Control IP-71, Kennedy Valve Model 2945, or equal.

## BACKFLOW PREVENTION ASSEMBLIES

Control assemblies such as reduced pressure principle assemblies and reduced pressure principle detector assemblies shall be limited to those approved by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California.

Double Check Valve Assembly (DCA): The double check valve backflow preventer assembly shall be ASSE® Listed 1048, and supplied with full port gate valves. The main body and access cover shall be epoxy coated ductile iron (ASTM A 536 Grade 4), the seat ring and check valve shall be Noryl™ (NSF listed), the stem shall be stainless steel (ASTM A 276) and the seat disc elastomers shall be EPDM. The first and second check valves shall be accessible for maintenance without removing the device from the line. The double check backflow prevention assembly shall be a FEBCO Model 805, Watts Series 007, Wilkins Model 950XL or equal.

Reduced Pressure Principle Backflow Preventer (RP) and Reduced Pressure Detector Assembly (RPDA): The reduced pressure principle backflow preventer shall be a complete assembly consisting of two independently acting springloaded toggle lever check valves together with an automatically operating pressure differential relief valve located between the two check valves. The first check valve shall reduce the supply pressure a predetermined amount so that during normal flow and the cessation of normal flow, the pressure between the checks is less than the supply pressure. In the case of leakage of either check valve, the differential relief valve shall discharge to atmosphere to maintain the pressure between the checks, less than the supply pressure.
The unit shall include tightly closing shutoff valves located at each end of the device, and shall be fitted with four test cocks. Operation shall be completely automatic. All internal parts of the toggle lever check valves and pressure differential relief valve must be removable or replaceable without removal of the backflow preventer assembly from the line. The reduced pressure backflow preventer shall be similar in all respects to the FEBCO Model 825YD (OS&Y), Watts Series 909-OSY, Wilkins Model 375-OSY or equal.

The reduced pressure detector assembly shall be similar in all respects to the FEBCO Model 826YD (OS&Y), Watts Series 909-RPDA, Wilkins Model 375-RPDA or equal.

## VALVE TAMPER SWITCH

Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

Valve Supervisory Switch shall be by McWane, Inc.; Kennedy Valve Division, Potter Electric Signal Company or System Sensor.

## PART 3 - EXECUTION

### GENERAL:

Install valves in the locations as shown on the drawings, plumb and centered and in absolutely true alignment. Support valves against settlement and misalignment with a suitable, lasting material as approved by the Engineer.

Clean valve interior of all foreign matter before installation. Tighten stuffing boxes and inspect valve in open and closed position to assure that all parts are working properly.

### PAINTING:

Paint all exposed ferrous metal with two coats of asphalt varnish such as 667 Utility Black by Tnemec, unless otherwise directed by the Engineer.

### BURIED SERVICE VALVES:

Install valve boxes for gate valves as indicated on the drawings. Adjust length of valve box to bring valve box cover to finished grade elevation. Center valve box over operating nut so that it fits around the stuffing box and rests on compacted ground. Align valve box so that it is plumb. Place and compact material in layers around valve box so as to prevent misalignment or shifting of the valve box or cover.

Where pavement is existing or proposed, the valve box shall be adjusted to finished street grade. When valve boxes are located in grassed or non-paved areas, install a pre-cast concrete collar (6" thick with 12" radius to the outer edge) to final grade.

Valve boxes shall be installed so that a minimum of four inches (4") of upward and four inches (4") of downward (total of eight inches (8") vertical adjustment is possible without disturbing the base or removal of any box sections unless directed otherwise by Engineer. Valve boxes for 2" ball valves shall be supported by two (2) bricks.

The Contractor shall adjust valve boxes to final grade at the time designated by the Engineer. No additional compensation will be made for valve box adjustment.

Valve Tamper Switches shall be installed on all post-indicator valves and Reduced Pressure Detector Assemblies.

**END OF SECTION 332120**

**SECTION 332130 – WATER PIPE ACCESSORIES**

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of work covering pipe accessories includes furnishing, installing, and making operational all accessories as indicated on the drawings and specified herein.

Related Work Specified Elsewhere:

Common Work Results for Utilities: Section 330500
Water Pipe and Pipe Fittings: Section 332110
Water Valves: Section 332120

QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards

Manufacturer's Capabilities: Supplier of accessory items shall be regularly engaged in the manufacture of products of types and sizes required, and which have been in satisfactory use for not less than one year in similar service.

SUBMITTALS:

Shop Drawings: Submit shop drawings or product data for all accessory items.

PART 2 - PRODUCTS

GENERAL:

Provide factory-fabricated piping accessories as hereinafter specified for use in the service indicated. Provide products of the type and pressure-rating indicated for each service or, if not indicated, provide proper selection as determined by the piping system installer to comply with installation requirements. Provide sizes and connections matching pipe, tube, valve and equipment connections.

Fire Hydrants: Fire hydrants shall be in accordance with AWWA Standard C502, latest revision thereof, suitable for an operating pressure of not less than 150 pounds per square inch and shall have a traffic breakable feature (safety flange and stem coupling), dry top, sealed lubrication reservoir and a main valve which is held closed with pressure. The hydrant body shall be of cast iron with "O" ring seals and bronze threads on the seat ring and drain ring, and shall have two (2) 2 1/2-inch nozzles and one (1) 4 1/2-inch nozzle with caps having National Standard threads. The hydrant main valve shall be a minimum of 5 1/4 inches in diameter. All continuously wetted hydrant parts and surfaces shall be of corrosion resistant materials or be epoxy coated with epoxy recognized by AWWA for potable water use. The epoxy coating shall be of a color other than black (unless the work "epoxy" is stenciled on the base) to permit distinction between standard and epoxy coatings to be made easily. Hydrants shall be American Flow Control B-84-B, Clow Medallion or Mueller A-423.

The inlet shoe for fire hydrant shall have a six inch (6") inside diameter and shall be cast or ductile iron with mechanical joint fittings in accordance with AWWA Standard C110.

Locked hydrant tees and fittings for fire hydrants shall meet the requirements of AWWA Standard C-111 (ANSI A21-11). Locked tees shall be as manufactured by American Cast Iron Pipe Company, Clow, U.S. Pipe, or approved equal.

Detectable Marking Tape (Tracing Tape): Tape shall be three (3) inches in width with a minimum thickness of 0.5 millimeters (minimum solid center foil thickness of 0.35 millimeters). Color of the tape shall be blue meeting the American Water Works Association color code. Tape shall read: “Caution- Buried Water Line Below”. Tape shall be manufactured by Lineguard, Inc., Pro-Line Safety products Co., Empire Level Mfg. Corp., or approved equal.

Heated Insulated Enclosure: The enclosure manufacturer shall be a company specializing in the manufacture of such enclosures with at least five (5) years of successful field experience and being lab certified as meeting A.S.S.E 1060 requirements. The enclosure shall be manufactured of Mill finish aluminum, ASTM B209. Insulation shall be polyisocyanurate foam: spray applied, frothed in place or board stock laminated between two (2) layers of fiberglass mat.

The insulation shall have the following properties:
1. Dimensional stability - less than 2% linear change.
2. Comprehensive strength - 20 PSI.

3. Water absorption - less than 1% by volume.
4. Density - nominal 2.0 lbs. per cubic foot.
5. Flame spread -25.
6. Service temperature - 100 degrees F to
7. 250 degrees F.
8. Insulation thickness shall be 1" for enclosures up to 2" IPS and 1.5" for 2.5 " IPS and above.

The roof, walls and access panels shall be constructed of the specified materials in the specified thicknesses. Multi-sectional enclosures shall fit together with overlapping "tongue and groove" joints and be secured internally with mechanical fasteners. The enclosure shall be securely attached to a concrete base with anchor brackets installed on the interior of the enclosure, through the flange base of the enclosure itself or through a stainless steel anchor hinge. Access panels shall be provided to allow easy access for operation, maintenance and testing of backflow prevention assembly without removal of assembly. Access panels shall be secured with padlock hasps and staples. Drain openings shall be designed to remain closed except when device is discharging water. Openings shall be designed to accommodate the maximum discharge of the device, and, shall protect against intrusion of wind, debris and animals, through the use of separate aluminum screen and wind flaps.

Heating Equipment shall be furnished and designed by the manufacturer of the enclosure to maintain and interior temperature of +40 degrees F with an exterior outside temperature of -30 degrees F and a wind velocity of 15 MPH. The factory assembled heating equipment shall be UL, ETL, or CSA certified. Electric power source for heat and accessories shall be G.F.I. protected, with 18" clearance from receptacle base to grade.

Mounting Hardware shall be furnished and shall be stainless steel. All assembly fasteners shall be stainless steel or aluminum. Anchor hardware shall be adjustable up to 1.5" vertically to accommodate uneven concrete slabs.

## PART 3 - EXECUTION

### GENERAL:

Install all piping accessories as shown on the drawings complying with all applicable portions of Section 02511 - Pipe and Pipe Fittings, manufacturers' instructions and as directed. Provide accessories of the sufficient size and ratings if not shown to complete and make ready for service all piping systems.

Touch-up paint all surfaces where the primer paint has been damaged or scarred during installation.

All ferrous-metal surfaces for underground installation shall be coated with a bitumastic paint.

**END OF SECTION 332130**

# SECTION 332140 - WATER SERVICES

## PART 1 - GENERAL

### RELATED DOCUMENTS

The general provisions of the Contract, including the General and Special Conditions and Division - 1 Specification sections apply to work of this section.

### DESCRIPTION

The extent of work covering services includes furnishing, installing and making operational all water service items as indicated on the drawings and specified here.

Related Work Specified Elsewhere:

General Provisions: Section 330500
Pipe and Pipe Fittings: Section 332130

### QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards
Greenville Utilities Commission Design Manual

Manufacturer's Capabilities: Supplier of water service items shall be regularly engaged in the manufacture of products of types and sizes required, and which have been in satisfactory use for not less than five years in similar service.

### SUBMITTALS:

Shop Drawings: Submit shop drawings or product data for all water service items.

PART 2 - PRODUCTS

GENERAL:

Provide factory-fabricated water service materials as hereinafter specified for use in the manner indicated. Provide products of the type, size and pressure-rating indicated or required. The materials for ¾" and 1" services are identical except for the meter which is installed by the Commission. Also, materials for 1-1/2" and 2" services are identical except for the meter vault which is installed by the Commission.

Materials for ¾" and 1" Water Services

Service Saddles: Service saddles shall be made of materials conforming to AWWA copper alloy No. C83600 with 1" (AWWA) CC outlet thread and an O-ring cemented in a confined groove. Service saddles shall be only those listed below.

| Type Main | Main Size | Approved Saddle Mfg & Model # |
|---|---|---|
| PVC (IPS) | 2" | Ford S70-204, Mueller H-13420, Hayes 527 A.0400 Series, A Y McDonald Style 3801 |
| ACP/DIP/CIP | 4" - 12" | Ford Style 202B, Mueller BR 2 B Series, A Y McDonald Style 3825 |
| PVC (C-900) | 4" - 12" | Ford S90 Series, Mueller H-13440 thru 13444 Series, A Y McDonald Style 3805, Hayes 527 Series |
| PVC (Sch 40 IPS) Steel Pipe | 4"- 12" | Ford S70 Series, Hayes 527 Series, Mueller H-13428 through H-13435 Series, A Y McDonald Style 3801 |

Corporation Stops: One-inch (1") corporation stops shall be bronze body with (AWWA) CC tapered threaded inlet and compression connection outlet. Stops shall be Hayes 4400 CJ, Mueller P-15008, or Ford F1000-4, A Y McDonald 4701-22, or approved equal.

Service Tubing: Service tubing shall be 1" diameter seamless copper type K suitable for underground water services. Materials shall be supplied in conformance with ASTM B88, type K.

Angle Ball Valve Meter Stop: One inch angle ball valve meter stops shall be bronze body with compression seal inlet connection and threaded outlet for meter connection. Stops shall be Ford BA43-444W, Hayes 2520CJ, A Y McDonald 4602B-22, Mueller P-24258, or approved equal.

Service Couplings: Service Couplings for 1" water services shall be bronze body with compression seal inlet connections with a stainless steel set screw. Couplings shall be Ford C44-44, Hayes 5615CJ, A Y McDonald 4758-22, Mueller p-15403, or approved equal.

Water Meter Boxes: Water meter boxes shall be manufactured of Class 30 cast iron in conformance with ASTM-A48 (latest revision thereof). The manufacturer's name and part number shall be cast into each component and the words "water meter" shall be cast into the cover. Boxes shall be Vulcan Foundry G8404-1 Frame with G8404 lid or a Sigma MB382 Capitol Foundry MBX1

Materials for 1-1/2" and 2" Water Services

Service Saddles: Service saddles shall be made of materials conforming to AWWA copper alloy No. C83600 with 2" (NPT) FIP outlet thread and an O-ring cemented in a confined groove. Service saddles shall be only those listed below.

| Type Main | Main Size | Approved Saddle Mfg & Model # |
|---|---|---|
| PVC (IPS & Sch. 40) | 4" – 12" | Ford S71 Series, Hayes 527P Series, A Y McDonald Style 3802 |
| ACP/DIP/CIP | 4" - 12" | Ford Style 202B, Mueller BR 2 B Series, A Y McDonald Style 3826 |
| PVC (C-900) | 4" - 12" | Ford S91 Series, Mueller H-13490 thru 13494 Series, A Y McDonald Style 3806, Hayes 529P Series |

Ball Valve: Ball Valves shall be bronze body with tee head. The turn required to travel from fully closed to fully open position shall be 90 degrees. Ball valves shall incorporate a check allowing a maximum turn of 90 degrees. Ball valves shall be Hayes 4300, Ford B11-777, A Y McDonald 6101, Mueller B-20283, or approved equal.

Service Piping: Service pipe shall be PVC Class 200 (IPS) and conforming to the latest revisions of ASTM D1784 and ASTM D2241. The pipe joints shall be of the integral bell type with rubber gaskets conforming to ASTM D31139 and F477. The pipe shall be SDR 21 and shall bear the National Sanitation Foundation seal for potable water. Fittings shall be schedule 80 PVC with solvent weld joints.

PART 3 - EXECUTION

GENERAL:

Install all water service items as shown on the drawings complying with manufacturer instructions and as directed. Provide water service materials of required size to complete and make ready for service to customer.

Services shall be provided to each lot or individual building unit as required by Section 3.2.9 of the GUC Design Manual and as shown in the Standard Details. Meter boxes and brick for one-inch (1") services shall be provided by the Contractor as shown on the Standard Details. Meter boxes installed for multi-family developments and ganged together shall be marked with the unit number being served. Markings shall be permanently painted on the inside of the frame section and highly visible.

Standard services are available utilizing 3/4", 1", 1 1/2", and 2" meters. Service tubing for 3/4", and 1" services shall be 1" diameter. Service pipe for 1-1/2" and 2" services shall be 2" diameter. For additional information, refer to the Standard Details. Larger services such as four- inch (4"), six-inch (6"), eight-inch (8"), etc., may be specified. Services larger than two-inch (2"), if used, shall be designed as a dead-end water main except that a permanent blow-off rather than a hydrant may be provided for flushing purposes.

Service connections for one-inch (1") services shall be installed by one of two (2) methods. These are as follows:

Service connections to PVC (C900) and ductile iron mains six inches (6") in diameter or larger may be accomplished by direct tapping of the main. Teflon tape or other approved pipe compound shall be applied to the corporation stop threads prior to installation.

Service connections for mains smaller than six-inches (6") and all sizes of pressure rated PVC require the use of a service clamp. A service clamp shall also be used as an alternative to tapping wherever required by the Commission.
One-inch (1") service tubing shall be installed with sufficient slack to prevent tension on the line. A maximum of three splices (couplings) per service shall be allowed. Tubing shall have a minimum cover of twenty-four inches (24"). See the Standard Details.

Service tubing shall be installed with a minimum of six inches (6") of vertical separation from an existing or proposed storm drain.

If the service tubing is damaged during construction such that its flow capacity or its life expectancy is adversely affected, the damaged portion shall be replaced.

One and one-half inch (1-1/2") and two-inch (2") diameter services shall be installed in accordance with the Standard Details. The installation of the Class 200 PVC service pipe shall

be in strict conformance with the requirements for mains, except that the service pipe shall have a minimum cover of twenty-four inches (24").

END OF SECTION 332140

**SECTION 333100 - GRAVITY SANITARY SEWER SYSTEM**

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of sanitary sewer system work is shown on the drawings.

Types of sanitary sewer facilities include the following:

Service Laterals

Related Work Specified Elsewhere:

Trenching, Backfilling and Compaction: Section 312200
Concrete Paving: Section 321313

QUALITY ASSURANCE:

Codes and Standards: Comply with applicable standards contained herein and with the requirements of NCDENR.

Testing and Inspection: Contractor shall provide all necessary equipment and materials and shall perform the visual inspections, air testing and infiltration testing of the system in conformance with the requirements of this section.

SUBMITTALS:

Material Certificates:

Provide materials' certificates for pipe and manholes.

Shop Drawings: Submit shop drawings and/or product data for all pipe and fittings, pipe gaskets, transitions, precast manholes, sewer brick, manhole covers and frames, and manhole steps.

## PART 2 - PRODUCTS

### SERVICES:

Sewer Service Pipe: Sewer service pipe shall be Schedule 40 PVC- Drain, Waste and Vent (DWV) pipe in accordance with ASTM D2665 and ASTM D1785. Cleanouts shall be constructed of pipe and fittings which also meet the ASTM requirements for Schedule 40 PVC-DWV pipe. Cleanout caps shall be Charlotte 110 or Jones BP134CSK flush cap. Cleanouts in traffic or paved areas shall be installed with a sewer cleanout box set to finished grade as shown in the standard details.

Service Fittings: Service saddles for use with ABS composite sewers shall be ABS saddle wyes as manufactured by Contech Construction Products, Inc. or approved equal. Wyes shall be chemically welded using the manufacturer's recommended primer, cement, and stainless steel bands.

Service fittings for use on PVC Composite Pipe shall be PVC standard gasketed wyes manufactured or approved by the pipe manufacturer and shall conform to the requirements of ASTM D2680.

Service fittings for use on PVC (SDR 35) pipe shall be standard gasketed wyes manufactured or approved by the pipe manufacturer and shall conform to the requirements of ASTM D3034.

Transition Coupling: Pipe material changes between manholes may be permitted provided there is not a substantial difference in inside diameters, a smooth uniform flow line is maintained, and a watertight rubber sleeve or mechanical coupler conforming to ASTM C-425 is used to make the transition. All metal hardware shall be stainless steel. Transition sleeves shall be manufactured by Fernco or Indiana Seal.

## PART 3 - EXECUTION

### GENERAL:

Adherence to Standards and Instructions: All pipe shall be transported, handled, stored, and installed in keeping with applicable AWWA/ASTM standards and manufacturer's instructions for the particular pipe material involved.

Responsibility for Materials: During loading, transportation, unloading and storage, every precaution shall be taken to prevent damage to pipe, fittings, and accessories and to keep them free from dirt and foreign matter at all times. Particular care shall be taken to prevent damage to pipe and fitting linings and coatings. Pipe shall be protected during handling against impact shocks or free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate specifications. ABS or PVC pipe shall be protected from ultra-violet rays and from warping in accordance with manufacturer's recommendations.

INSTALLATION:

Pipe Laying: Each joint of pipe shall be carefully examined before being laid. Defective pipe shall be clearly marked and placed aside. Defective pipe shall not be installed.

Provide proper facilities for lowering pipe into trenches.

Ensure that the pipe bedding is set at true line and grade and is in conformance with the specifications.

Pipe shall be laid true to line and grade as designated on the plans with ends abutting. Each joint shall be tested for exact position by use of grade rod and plummet or laser. Carefully center the pipe so that when laid, they will form a sewer with a uniform invert. Ensure that when joining pipes of different wall thickness the inverts of the pipe joints form a smooth line.

Pipe having its grade or joint disturbed after laying shall be taken up, cleaned and relaid.

Pipe installed by use of laser shall be checked for proper grade with engineering level and grade rod at each manhole prior to continuing pipelaying operations. Additional checks every 50 feet may be required by the Engineer.

The Contractor shall not be allowed to skip any section of the pipe line and move further upgrade, except as special permission is granted by the Engineer, or when the Contractor has more than one complete pipe laying crew working on the project.

Stone embedment shall be as indicated in Trenching, Backfilling, and Compaction Section 02220.

All pipe shall be laid so that markings are on top. All pipe in place shall be inspected before being covered or concealed.

Keep trenches water-free and as dry as practicable during bedding, laying and jointing. Place sufficient backfill along each side of pipe as soon as practicable to brace pipe on line and grade.

Place a plastic stopper or other suitable device in the end of the last joint of pipe at the conclusion of each day's work or at other times when pipe laying is not in progress.

Prevent the entry of water, dirt, tools or other foreign matter into the pipe line.

Ensure that bedding and backfill is installed in conformance with requirements of Trenching, Backfilling and Compaction Section 02220.

All joints shall be made in accordance with manufacturer recommendations. Ensure that the pipe is installed with at least a 1/8 inch per foot slope. Plug each service securely with a watertight plug.

TESTING AND INSPECTION OF SYSTEM:

Testing and inspection shall promptly follow installation of wastewater pipe including services. Testing shall not be more than 1,000 feet behind wastewater pipe laying operation.

Furnish all pumps, gauges, instruments, test equipment and personnel required for inspection and testing operations.

All final testing and inspections shall be performed in the presence of the Resident Project Representative.

Inspect the system for conformance with line and grade shown on the plans and provide record drawing measurements per Section 01300 - Submittals. The maximum allowable drift between structures from proposed alignment is:

| | |
|---|---|
| Horizontal alignment: | 0.20 foot |
| Vertical Grade: | 0.05 foot |

Inspect the system for visible leaks (air or water). Repair all visible leaks. Correct all deviations from line and grade.

Materials removed to correct deficiencies revealed by tests and inspections shall not be reused. Pipe removed due to faulty grade shall be replaced with new pipe.

The following test sequence shall be included in the Contract Documents for all wastewater system extension unless otherwise permitted by the Engineer.

1. Perform a visual inspection.
2. Correct defects revealed by visual inspection.
3. Perform leakage testing.
4. Make any necessary repairs.
5. Make the necessary retests.

Leakage Testing For Gravity Sewers:

Unless otherwise permitted or required by the Engineer, leakage testing for gravity sewers shall be by low-pressure air test. Infiltration or exfiltration testing of the lines in lieu of air testing shall not be accepted without prior written approval of the Engineer. All visible leaks shall be corrected regardless of the results of testing. All services, including those which discharge directly into manholes, shall be leakage tested.

**END OF SECTION 333100**

**SECTION 334100 - STORM SEWER SYSTEM**

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including General Supplemental General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

Related Work Specified Elsewhere:

Trenching, Backfilling and Compaction: Section 312200
Concrete Paving: Section 321313

DESCRIPTION OF WORK:

The extent of storm sewer system work is shown on the drawings.

Storm sewer system work includes, but is not limited to, all of the following.

Storm sewer pipe.

Drop inlets, frames and gratings.

Curb inlets, frames and gratings.

Reinforced concrete and brick junction box.

QUALITY ASSURANCE:

Code and Standards: Comply with requirements of applicable Division - 2 sections for excavation and backfilling required in connection with storm sewer system work.

SUBMITTALS:

Shop Drawings, Storm Sewer and Sanitary Sewer System: Submit shop drawings for the system, including details of underground structures, metal accessories, fittings, and connections, and any variations from those details shown on the drawings.

## PART 2 - PRODUCTS

### CONDUIT MATERIALS:

Reinforced Concrete Pipe (RCP): Concrete Pipe shall be in accordance with ASTM C-76, Class III All pipe shall have tongue-and groove type joint. All pipe shall be stamped by supplier - "R.C.". Joint material shall be RAM-NEK Performed Plastic Gasket, Type I rope form sealing compound conforming to Federal Specifications SS-S-210A.

Polyvinyl Chloride (PVC): PVC storm sewer pipe and fittings shall be manufactured and tested in accordance with ASTM F949. PVC pipe shall be manufactured from 12454 cell class material per ASTM D1784. Pipe and fittings shall have a minimum pipe stiffness of 46 lbs/in/in when tested in accordance with ASTM D2412. Joints shall be integral bell-gasketed joint.

### MASONRY MATERIALS:

Concrete Masonry Units (Manhole Block): ASTM C 139.

Manhole Drop Inlet and Catch Basin Brick: ASTM C 32, Grade MS.

Concrete Brick: ASTM C 55, Grade N1.

Masonry Mortar: ASTM C 270, Type M, approximately 1:1/4:2 Portland cement, lime, sand.

Concrete Block: ASTM C-90, Grade N 1.

For minor amounts of mortar, packaged materials complying with ASTM C 387, Type M, will be acceptable.

Plasticizing Agent - Omicron or equal. Use in accordance with manufacturer's instructions.

### METAL ACCESSORIES:

General: All metal accessories for manholes, catch basins and drop inlets shall be gray cast iron, ASTM A 48, Class 30B. Frames, grates and covers shall be factory coated with an asphalt base paint. Install metal accessories as shown on the drawings and as follows:

Manhole frames and covers shall be NCDOT Roadway Design Std. No. 840.54. Furnish covers with cast-in legend “Storm” on roadway face.

Catch basin frames and grates shall be NCDOT Roadway Design Std. No. 840.03 Type “E.”

Drop inlet frames and grates shall be NCDOT Roadway Design Std. No. 840.16.

Manhole steps shall be plastic coated steel bar or cast iron as shown in NCDOT Roadway Design Std. No. 840.66.

Temporary Silt Fence: Temporary silt fence shall be accomplished in accordance with Section 1605 of the N.C. Department of Transportation Standard Specifications for Roads and structures dated January 2002 and as shown on the plans.

## PART 3 - EXECUTION

### INSPECTION:

Contractor must examine the areas and conditions under which storm sewer system work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

### INSTALLATION OF CONDUIT (PIPE):

#### General:

Perform excavation, trenching and backfilling as specified in appropriate Division-2 Sections. Conduct backfill operations of open-cut trenches closely following laying, jointing and bedding of pipe, and after initial inspection and testing are completed.

Inspect conduit before installation to detect any apparent defects. Mark defective materials with white paint and promptly remove from the site.

Particular care shall be taken to prevent damage to pipe and fitting linings and coatings. Pipe shall be protected during handling against impact shocks and free fall.

Lay conduit beginning at the low point of a system, true to the grades and alignment indicated with unbroken continuity of invert. The line and invert grade of each pipe shall be checked from top line carried on batter boards not over 24' apart or by a laser and target.

Cross above or below other pipe a minimum of 6" unless otherwise directed by the Engineer.

Place bell ends of conduit or the groove end of concrete facing upstream.

Bell holes shall be excavated for each joint to assure bedding supports the barrel of the pipe and to facilitate making a perfect joint. Preparatory to making pipe joints, all surfaces of the portion of the pipe to be jointed or of the factory-made jointing materials shall be clean and dry.

Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

Cleaning Conduit: Clear the interior of conduit of dirt and other superfluous material as the work progresses.

Place plugs in the ends of uncompleted conduit at the end of the day or whenever work stops.

Flush lines between manholes if required to remove collected debris.

Interior Inspection: Inspect conduit to determine whether line displacement or other damage has occurred.

A light held in a manhole shall show a full circle of light when viewed from the adjoining end of the line.

Make inspections after lines between manholes, or manhole locations, have been installed and approximately two feet of backfill is in place and at completion of the project.
If the inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, take whatever steps are necessary to correct such defects to the satisfaction of the Engineer.

Connection to Existing Structures: Pipe connections to existing structures shall be made in such manner that the finished work will conform as nearly as practicable to the essential applicable requirements specified for new structures, including all necessary concrete work, cutting, and shaping.

UNDERGROUND STRUCTURES:

General: Drainage structures may be precast sections or constructed with concrete masonry units (manhole block) or concrete brick masonry as specified under Part 2 - Products unless otherwise noted. Construct all drainage structures with a grouted invert to channel flow through structure from inlet pipes to outlet pipe. Where pipes are skewed, the grouted channel shall form a smooth radius. Structures shall not be backfilled until inspected by the Engineer or his representative unless otherwise directed.

Construct all structures in accordance with all authorities having jurisdiction and as hereinafter specified.

Masonry Construction: At Contractor's option, use either concrete brick or concrete masonry (manhole block) units.

Mix mortar with only enough water for workability. Re-tempering of mortar will not be permitted. Keep mortar mixing and conveying equipment clean. Do not deposit mortar upon, or permit contact with, the ground.

Lay masonry in mortar so as to form full bed with ends and side joints in one operation, and with full bed and vertical joints, not more than 3/8" wide on the inside. Protect fresh masonry from freezing and from too rapid drying.

Catch basins and Junction boxes: Construct to the sizes and shapes as shown on the drawings and as specified.

Use concrete that will attain a 28-day compressive strength of not less than 3,000 psi.

Set cast iron frames and gratings to the elevations indicated.

**END OF SECTION 334100**