ETSU VA CAMPUS BUILDING 2 RENOVATION

OCCUPATIONAL THERAPY AND ORTHOTICS & PROSTHETICS PROGRAMS
SBC# 369/005-06-2020

BID DOCUMENTS
May 13th, 2021

EAST TENNESSEE STATE UNIVERSITY
COLLEGE OF CLINICAL AND REHABILITATIVE HEALTH SCIENCES
ETSU VA CAMPUS BUILDING #2
JOHNSON CITY, TN  37614

STRUCTURAL ENGINEER
Lynch Mykins Structural Engineers, PC
301 N. West Street, Suite 105
Raleigh, NC  27603

ARCHITECT
Clark Nexsen
210 East Watauga Avenue
Johnson City, TN  37601

MECHANICAL, ELECTRICAL, PLUMBING & FIRE PROTECTION ENGINEER
Clark Nexsen
210 East Watauga Avenue
Johnson City, TN  37601
1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Chadwick S. Roberson, AIA.
2. TN #106676.
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.
B. Structural Engineer:
   1. Dave Mykins
   2. TN# 124485

[Signature]

[Seal: State of Tennessee]

06/01/21
C. Fire-Protection Engineer:

1. Chris Born, PE.
2. TN# 104606
3. Responsible for Division 21 and 28.
D. HVAC & Plumbing Engineer:

1. Wade Williams, PE.
2. 124526.
3. Responsible for Division 22 and 23.
E. Electrical Engineer:

1. Pat Rose, PE.
2. 110670.
### SECTION 00 01 10 - TABLE OF CONTENTS

**DIVISION – 00 PROCUREMENT AND CONTRACTING REQUIREMENTS**

<table>
<thead>
<tr>
<th>Seite</th>
<th>Überschrift</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 01 01</td>
<td>PROJECT TITLE PAGE</td>
</tr>
<tr>
<td>00 01 07</td>
<td>SEALS PAGE</td>
</tr>
<tr>
<td>00 01 10</td>
<td>TABLE OF CONTENTS</td>
</tr>
<tr>
<td>00 11 16</td>
<td>INVITATION TO BID</td>
</tr>
<tr>
<td>00 21 13</td>
<td>INSTRUCTIONS TO BIDDERS</td>
</tr>
<tr>
<td>00 21 13.1</td>
<td>SUPPLEMENTARY INSTRUCTIONS TO BIDDERS</td>
</tr>
<tr>
<td>00 22 20T</td>
<td>MAP TO BID OPENING LOCATION</td>
</tr>
<tr>
<td>00 31 26</td>
<td>ASBESTOS SURVEY INFORMATION AVAILABLE TO BIDDERS</td>
</tr>
<tr>
<td>00 41 13</td>
<td>BID FORM</td>
</tr>
<tr>
<td>00 45 21</td>
<td>DRUG FREE WORKPLACE AFFIDAVIT</td>
</tr>
<tr>
<td>00 47 13</td>
<td>CONSTRUCTION BID ENVELOPE</td>
</tr>
<tr>
<td>00 52 13</td>
<td>AGREEMENT</td>
</tr>
<tr>
<td>00 61 13</td>
<td>CONTRACT BOND</td>
</tr>
<tr>
<td>00 72 13</td>
<td>GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION</td>
</tr>
</tbody>
</table>

**DIVISION – 01 GENERAL REQUIREMENTS**

**SUMMARY**

<table>
<thead>
<tr>
<th>Seite</th>
<th>Überschrift</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 10 00</td>
<td>SUMMARY OF WORK</td>
</tr>
<tr>
<td>01 21 13</td>
<td>ALLOWANCES</td>
</tr>
<tr>
<td>01 21 15</td>
<td>LIST OF ALLOWANCES</td>
</tr>
<tr>
<td>01 22 13</td>
<td>UNIT PRICES</td>
</tr>
<tr>
<td>01 22 15</td>
<td>LIST OF UNIT PRICES</td>
</tr>
<tr>
<td>01 23 00</td>
<td>ALTERNATES</td>
</tr>
<tr>
<td>01 25 13</td>
<td>PRODUCT SUBSTITUTION PROCEDURES</td>
</tr>
<tr>
<td>01 25 33</td>
<td>PRODUCT SUBSTITUTION REQUEST FORM</td>
</tr>
<tr>
<td>01 26 00</td>
<td>CONTRACT MODIFICATION PROCEDURES</td>
</tr>
<tr>
<td>01 26 20</td>
<td>WEATHER DELAYS</td>
</tr>
</tbody>
</table>

**PRICE AND PAYMENT PROCEDURES**

<table>
<thead>
<tr>
<th>Seite</th>
<th>Überschrift</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 25 13</td>
<td>PRODUCT SUBSTITUTION PROCEDURES</td>
</tr>
<tr>
<td>01 25 33</td>
<td>PRODUCT SUBSTITUTION REQUEST FORM</td>
</tr>
<tr>
<td>01 26 00</td>
<td>CONTRACT MODIFICATION PROCEDURES</td>
</tr>
<tr>
<td>01 26 20</td>
<td>WEATHER DELAYS</td>
</tr>
<tr>
<td>01 26 25</td>
<td>WEATHER DELAYS REPORT</td>
</tr>
<tr>
<td>01 26 40</td>
<td>FORM FOR AMENDMENT, CHANGE ORDER, OR DIRECTIVE</td>
</tr>
<tr>
<td>01 26 54</td>
<td>FORM FOR PRICE SUMMARY</td>
</tr>
<tr>
<td>01 26 55</td>
<td>FORM FOR PRICE OF WORK</td>
</tr>
<tr>
<td>01 26 56</td>
<td>FORM FOR PRICE OF TIME</td>
</tr>
<tr>
<td>01 29 54</td>
<td>RETAINAGE ESCROW INITIATION</td>
</tr>
<tr>
<td>01 29 73</td>
<td>SCHEDULE OF VALUES</td>
</tr>
<tr>
<td>01 29 76</td>
<td>PROGRESS PAYMENT PROCEDURES</td>
</tr>
</tbody>
</table>

**ADMINISTRATIVE REQUIREMENTS**

<table>
<thead>
<tr>
<th>Seite</th>
<th>Überschrift</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 31 00</td>
<td>PROJECT MANAGEMENT AND COORDINATION</td>
</tr>
</tbody>
</table>
01 31 90  ADMINISTRATIVE LOGS
01 31 93  VISITOR LOG
01 32 00  CONSTRUCTION PROGRESS DOCUMENTATION
01 32 33  PHOTOGRAPHIC DOCUMENTATION
01 33 00  SUBMITTAL PROCEDURES

QUALITY REQUIREMENTS
01 40 00  QUALITY REQUIREMENTS
01 41 15  BASIC REGULATORY REQUIREMENTS
01 45 29  TESTING LABORATORY SERVICES

TEMPORARY FACILITIES AND CONTROLS
01 50 00  TEMPORARY FACILITIES AND CONTROLS

PRODUCT REQUIREMENTS
01 60 00  PRODUCT REQUIREMENTS

EXECUTION AND CLOSEOUT REQUIREMENTS
01 73 00  EXECUTION
01 74 19  CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 77 70  CLOSEOUT PROCEDURES
01 78 02  CLOSEOUT SUBMITTALS
01 78 23  OPERATION AND MAINTENANCE DATA
01 78 25  DATA BINDER RECEIPT
01 78 39  PROJECT RECORD DOCUMENTS
01 78 88  REPORT OF SUBCONTRACTORS AND SUPPLIERS
01 79 21  DEMONSTRATION AND TRAINING
01 79 25  DEMONSTRATION AND TRAINING VERIFICATION
01 81 14  HIGH PERFORMANCE BUILDING REQUIREMENTS (HPBr)
01 81 14.1 HPBr CHECKLIST
01 81 14.2 HPBr CREDIT VERIFICATION FORM
01 81 14.3 HPBr MATERIALS AND RESOURCES CALCULATOR
01 91 13  COMMISSIONING
01 91 23  PERFORMANCE TESTING IDENTIFICATION FORM
01 91 26  PERFORMANCE TESTING PROCEDURES FORM
01 91 29  FUNCTIONAL PERFORMANCE TEST CERTIFICATION

DIVISION – 02  EXISTING CONDITIONS
02 41 19  SELECTIVE DEMOLITION
02 82 13  ASBESTOS ABATEMENT

DIVISION – 03  CONCRETE
NOT USED

DIVISION – 04  MASONRY
NOT USED

DIVISION – 05  METALS
05 12 00  STRUCTURAL STEEL FRAMING
DIVISION – 06  WOOD, PLASTICS, AND COMPOSITES
06 10 53  MISCELLANEOUS ROUGH CARPENTRY
06 16 00  SHEATHING
06 40 23  INTERIOR ARCHITECTURAL WOODWORK

DIVISION – 07  THERMAL AND MOISTURE PROTECTION
07 21 00  THERMAL INSULATION
07 62 00  SHEET METAL FLASHING AND TRIM
07 81 00  APPLIED FIREPROOFING
07 84 13  PENETRATION FIRESTOPPING
07 84 43  JOINT FIRESTOPPING
07 92 00  JOINT SEALANTS

DIVISION – 08  OPENINGS
08 11 13  HOLLOW METAL DOORS AND FRAMES
08 14 16  FLUSH WOOD DOORS
08 31 13  ACCESS DOORS AND FRAMES
08 33 23  OVERHEAD COILING DOORS
08 56 19  INTERIOR SLIDING PASS WINDOWS
08 71 00  DOOR HARDWARE
08 80 00  GLAZING
08 90 00  LOUVERS AND VENTS

DIVISION – 09  FINISHES
09 22 16  NON-STRUCTURAL METAL FRAMING
09 29 00  GYPSUM BOARD
09 30 13  TILING
09 51 23  ACOUSTICAL TILE CEILINGS
09 51 24  OPEN LINEAR WOOD CEILING AND WALL SYSTEM
09 65 13  RESILIENT BASE AND ACCESSORIES
09 65 19  RESILIENT TILE FLOORING
09 68 13  TILE CARPETING
09 77 00  DECORATIVE FIBERGLASS REINFORCED WALL
09 84 34  CEMENTIOUS WOOD FIBER ACOUSTIC PANELS
09 91 23  INTERIOR PAINTING

DIVISION – 10  SPECIALTIES
10 11 00  VISUAL DISPLAY UNITS
10 14 23  PANEL SIGNAGE
10 22 30  OPERABLE PARTITIONS
10 26 00  WALL AND DOOR PROTECTION
10 28 00  TOILET, BATH, AND LAUNDRY ACCESSORIES
10 44 13  FIRE PROTECTION CABINETS
10 51 29  PHENOLIC LOCKERS AND BENCHES
### DIVISION – 11  EQUIPMENT

**NOT USED**

### DIVISION – 12  FURNISHINGS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 36 61.19</td>
<td>QUARTZ AGGLOMERATE COUNTERTOPS</td>
</tr>
</tbody>
</table>

### DIVISION – 13  SPECIAL CONSTRUCTION

**NOT USED**

### DIVISION – 14  CONVEYING EQUIPMENT

**NOT USED**

### DIVISION – 21  FIRE SUPPRESSION

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 13 13</td>
<td>WET-PIPE SPRINKLER SYSTEMS</td>
</tr>
</tbody>
</table>

### DIVISION – 22  PLUMBING

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 05 13</td>
<td>COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT</td>
</tr>
<tr>
<td>22 05 16</td>
<td>EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING</td>
</tr>
<tr>
<td>22 05 17</td>
<td>SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING</td>
</tr>
<tr>
<td>22 05 18</td>
<td>ESCUTCHEONS FOR PLUMBING PIPING</td>
</tr>
<tr>
<td>22 05 19</td>
<td>METERS AND GAGES FOR PLUMBING PIPING</td>
</tr>
<tr>
<td>22 05 23.12</td>
<td>BALL VALVES FOR PLUMBING PIPING</td>
</tr>
<tr>
<td>22 05 23.14</td>
<td>CHECK VALVES FOR PLUMBING PIPING</td>
</tr>
<tr>
<td>22 05 29</td>
<td>HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT</td>
</tr>
<tr>
<td>22 05 53</td>
<td>IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT</td>
</tr>
<tr>
<td>22 07 19</td>
<td>PLUMBING PIPING INSULATION</td>
</tr>
<tr>
<td>22 11 16</td>
<td>DOMESTIC WATER PIPING</td>
</tr>
<tr>
<td>22 11 19</td>
<td>DOMESTIC WATER PIPING SPECIALTIES</td>
</tr>
<tr>
<td>22 13 16</td>
<td>SANITARY WASTE AND VENT PIPING</td>
</tr>
<tr>
<td>22 13 19</td>
<td>SANITARY WASTE PIPING SPECIALTIES</td>
</tr>
<tr>
<td>22 13 19.13</td>
<td>SANITARY DRAINS</td>
</tr>
<tr>
<td>22 14 13</td>
<td>FACILITY STORM DRAINAGE PIPING</td>
</tr>
<tr>
<td>22 14 23</td>
<td>STORM DRAINAGE PIPING SPECIALTIES</td>
</tr>
<tr>
<td>22 15 13</td>
<td>GENERAL-SERVICE COMPRESSED-AIR PIPING</td>
</tr>
<tr>
<td>22 15 19</td>
<td>GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS</td>
</tr>
<tr>
<td>22 42 13.13</td>
<td>COMMERCIAL WATER CLOSETS</td>
</tr>
<tr>
<td>22 42 16.13</td>
<td>COMMERCIAL LAVATORIES</td>
</tr>
<tr>
<td>22 42 16.16</td>
<td>COMMERCIAL SINKS</td>
</tr>
<tr>
<td>22 45 00</td>
<td>EMERGENCY PLUMBING FIXTURES</td>
</tr>
<tr>
<td>22 47 16</td>
<td>PRESSURE WATER COOLERS</td>
</tr>
</tbody>
</table>

### DIVISION – 23  HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 05 13</td>
<td>COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT</td>
</tr>
</tbody>
</table>

**TABLE OF CONTENTS**
| 23 05 17 | SLEEVES AND SLEEVE SEALS FOR HVAC PIPING |
| 23 05 18 | ESCUTCHEONS FOR HVAC PIPING |
| 23 05 19 | METERS AND GAUGES FOR HVAC PIPING |
| 23 05 23.12 | BALL VALVES FOR HVAC PIPING |
| 23 05 23.13 | BUTTERFLY VALVES FOR HVAC PIPING |
| 23 05 23.14 | CHECK VALVES FOR HVAC PIPING |
| 23 05 29 | HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT |
| 23 05 48.13 | VIBRATION CONTROLS FOR HVAC |
| 23 05 53 | IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT |
| 23 05 93 | TESTING, ADJUSTING, AND BALANCING FOR HVAC |
| 23 07 13 | DUCT INSULATION |
| 23 07 19 | HVAC PIPING INSULATION |
| 23 08 00 | MECHANICAL AND CONTROL SYSTEMS COMMISSIONING |
| 23 08 13 | SENSOR POINT CALIBRATION CHECK SHEET |
| 23 09 23 | DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC |
| 23 09 23.11 | CONTROL VALVES |
| 23 09 23.12 | CONTROL DAMPERS |
| 23 09 23.23 | PRESSURE INSTRUMENTS |
| 23 09 23.27 | TEMPERATURE INSTRUMENTS |
| 23 21 13 | HYDRONIC PIPING |
| 23 21 16 | HYDRONIC PIPING SPECIALTIES |
| 23 31 13 | METAL DUCTS |
| 23 33 00 | AIR DUCT ACCESSORIES |
| 23 33 46 | FLEXIBLE DUCTS |
| 23 34 13 | AXIAL HVAC FANS |
| 23 37 13.13 | AIR DIFFUSERS |
| 23 37 13.23 | REGISTERS AND GRILLES |
| 23 73 13.13 | INDOOR, BASIC AIR-HANDLING UNITS |
| 23 82 19 | FAN COIL UNITS |

**DIVISION – 26 ELECTRICAL**

| 26 05 19 | LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES |
| 26 05 23 | CONTROL-VOLTAGE ELECTRICAL POWER CABLES |
| 26 05 26 | GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS |
| 26 05 29 | HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS |
| 26 05 33 | RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS |
| 26 05 53 | IDENTIFICATION FOR ELECTRICAL SYSTEMS |
| 26 08 00 | ELECTRICAL AND LIGHTING SYSTEMS COMMISSIONING |
| 26 08 06 | PANELBOARD CHECK SHEET |
| 26 08 13 | POWER CIRCUIT CHECK SHEET |
| 26 08 50 | LIGHTING CHECK SHEET |
| 26 09 23 | LIGHTING CONTROL DEVICES |
| 26 24 16 | PANELBOARDS |
| 26 27 26 | WIRING DEVICES |
| 26 28 13 | FUSES |
| 26 43 13 | SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS |
| 26 51 19 | LED INTERIOR LIGHTING |
| 26 52 13 | EMERGENCY AND EXIT LIGHTING |
DIVISION – 27  COMMUNICATIONS
27 00  00  GENERAL COMMUNICATIONS
27 05  29  HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS
27 05  53  IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
27 08  00  COMMISSIONING OF COMMUNICATIONS SYSTEMS
27 10  20  STRUCTURED COMMUNICATION CABLING SYSTEM
27 11  00  COMMUNICATIONS EQUIPMENT ROOM FITTINGS
27 15  33  COAXIAL CABLES
27 05  26  GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
27 05  28  PATHWAYS FOR COMMUNICATIONS SYSTEMS
27 05  29  HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS
27 05  36  CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
27 05  44  SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND
           CABLES
27 11  00  COMMUNICATIONS EQUIPMENT ROOM FITTINGS
27 11  16  COMMUNICATION RACKS, FRAMES, AND ENCLOSURES
27 13  23  COMMUNICATIONS OPTICAL FIBER BACKBONE CABLES
27 15  13  COMMUNICATIONS COPPER HORIZONTAL CABLES

DIVISION – 28  ELECTRONIC SAFETY AND SECURITY
28 46  21.11  ADDRESSABLE FIRE-ALARM SYSTEMS

DIVISION – 31  EARTHWORK
31 05  13  SOILS FOR EARTHWORK
31 05  16  AGGREGATES FOR EARTHWORK
31 10  00  SITE CLEARING
31 22  13  ROUGH GRADING
31 23  16  EXCAVATION
31 23  17  EXCAVATION, BEDDING, AND BACKFILL FOR UTILITIES
31 23  18  ROCK EXCAVATION
31 23  19  DEWATERING
31 23  23  FILL
31 25  13  SLOPE PROTECTION AND EROSION CONTROL
31 31  16  TERMITE CONTROL

DIVISION – 32  EXTERIOR IMPROVEMENTS
32 01  15  PAVEMENT REPAIR
32 11  23  AGGREGATE BASE COURSES
32 92  19  SEEDING

DIVISION – 33  UTILITIES
33 01  32  SEWER AND MANHOLE TESTING
33 05  13  MANHOLES AND STRUCTURES
33 31  00  SANITARY UTILITY SEWERAGE PIPING
33 41  00  STORM UTILITY DRAINAGE PIPING
33 46  00  SUBDRAINAGE

END OF SECTION 00 01 10  TABLE OF CONTENTS
00 11 16 – INVITATION TO BID

PROJECT:
ETSU VA Campus Building 2 - 1st Floor Renovation
SBC Number 369/005-06-2020
TFM #07492-VV
Dogwood Avenue
VA Medical Center Campus
Mountain Home, TN  37684 / Washington County

INVITATION:
The State of Tennessee is inviting General Contractor bids for the Work of this project. Examine documents at the Designer's office or Plan Rooms on or after 5/19/2021.
Bidding Documents in PDF format may be obtained at no cost from the following source.
Clark Nexsen - Johnson City
(423) 929-2191
Entities obtaining Bidding Documents become Bidders of Record for notifications. Bidders of Record may purchase hard copies of Bidding Documents from the same source (nonrefundable).
Bidders shall be licensed and qualified per state law. Five percent (5%) Bid Security is required in the form of a Bid Bond or check (certified or cashier's) made payable to State of Tennessee. Non-discrimination policy applies.

BIDS RECEIVED AT:
Facilities Management
1380 Jack Vest Drive
Wilbur Bond Maintenance Building
East Tennessee State University
Johnson City, TN  37614
Until 2:00pm, local time
On June 16th, 2021

PRE-BID CONFERENCE AT:
Building #2 Dogwood Avenue
VA Medical Center Campus
Mountain Home, TN  37684
Washington County
At 2pm, local time
On May 26th, 2021
PLAN ROOMS:

Builders Exchange of Tennessee (BXTN)
Dodge Data & Analytics
Tri-Cities AGC of Tennessee

DESIGNER:

CLARK NEXSEN
210 East Watauga Avenue
Johnson City, TN  37601

END OF SECTION
PART 1 - GENERAL

1.01 BIDDING DOCUMENTS
   A. Bidding Documents may be obtained by Bidders and Subcontractors as described in the Invitation to Bid.
   B. Bidders of Record will be issued subsequent addenda.

1.02 EXAMINATION
   A. Bidders shall carefully examine site and documents to obtain first-hand knowledge of existing conditions and Work proposed.
   B. Contractor will not be given extra payment for conditions which can be determined by examining site and documents.

1.03 QUESTIONS
   A. Bidders shall submit questions about bidding documents to Designer in writing. Replies will be issued to Bidders of Record by addenda and will become part of Contract Documents. Designer and Owner will not make oral clarifications.
   B. Questions shall be received by Designer at least six calendar days before bid opening date.
   C. Normal practice is that no addenda affecting pricing will be issued less than three calendar days before bid opening date.

1.04 SUBSTITUTIONS
   A. Substitution requests before receipt of bids shall be prepared in accordance with 01 25 13 Product Substitution Procedures.
   B. Substitution requests before receipt of bids shall be received ten calendar days before date set to receive bids. However, regardless of the date received, consideration of substitution requests is not an obligation of the Designer or Owner and the Designer will determine if sufficient time is available for evaluation of the request.
   C. Acceptable substitutions will be identified in addenda.
   D. Bidders submitting bids in reliance upon a substitution when the substitution has not been approved prior to bidding do so at their own risk.

1.05 LICENSING AND QUALIFICATIONS
   A. Bidders shall be familiar with the Contractors Licensing Act of 1976, as currently amended (codified in Tennessee Code Annotated (TCA) § 62-6-101, et seq.). A contract will not be awarded to a bidder whose bid is in conflict with State licensing law.
   B. Bidders with five or more employees are required by TCA § 50-9-113 to submit a completed Section 00 45 21 Drug-Free Workplace Affidavit with their bid that attests they have a complying drug-free workplace program.
   C. In compliance with TCA § 50-9-114 bidders are advised that the Owner does not operate a certified drug-free workplace program that serves for compliance with TCA § 50-9-113.
D. Bids submitted shall not include a contractor or subcontractor disqualified from participating in State Building Commission projects. The State Architect maintains a list of those that are disqualified.

E. The bidder and its subcontractors shall not knowingly utilize the services of an illegal immigrant in the performance of the Work, and shall not knowingly utilize the services of any subcontractor, sub-subcontractor, or consultant who utilizes the services of an illegal immigrant in the performance of the Work.

F. In compliance with the Iran Divestment Act bids submitted shall not include a contractor or subcontractor on the list created pursuant to TCA § 12-12-106.

1.06 BID FORM

A. Make bids on an unaltered Bid Form. Submit one Bid Form. Failure to completely fill out Bid Form may cause bid to be rejected.

B. To indicate availability of an Add Alternate at no additional charge, write "No Charge" in the space. Additional stipulations or qualifications on Bid Form may cause bid to be rejected.

C. Bid Form shall be signed by person or persons legally authorized to bind Bidder to contract.

1.07 BID SECURITY

A. Bid Security is required in the amount of five percent (5%) of total amount of bid, including alternates, in the form of a Bid Bond or check (certified or cashier’s) made payable to State of Tennessee.

B. Bid Bonds shall be issued by Surety company licensed to do business in Tennessee by Tennessee Department of Commerce and Insurance, and shall have certified and current Power-of-Attorney for Attorney-in-Fact attached.

C. Owner may retain Bid Security of bidders to whom award is being considered until either (a) Contract has been executed, or (b) specified time has elapsed so that bid is not binding, or (c) bid has been rejected. If Bidder refuses to enter into Contract or fails to furnish all required attachments properly executed, the amount of Bid Security shall be forfeited to Owner as liquidated damages, not as penalty.

1.08 BID SUBMITTAL

A. Submit Bid Form, with required attachments, enclosed and sealed in a 9 inch by 12 inch Bid Envelope with Bid Envelope cover information as provided in Section 00 47 13 attached to the Bid Envelope. Bidder shall fill in blank spaces on face of Envelope except the blank space provided for Designer's approval.

B. If any work, regardless of dollar value, is required for any or of the subcontract trades listed on the Bid Envelope form, list subcontractor(s) that will perform that work. If Bidder will perform that work with Bidder's own forces, fill in Bidder's name as subcontractor. If no work is required in a category, write “None Required” in space provided for subcontractor(s). If acceptance of Alternate or combination of Alternates changes subcontractor, indicate change on Bid Envelope.

C. Provide State contractor license number, expiration date, and applicable classifications for Bidder and listed subcontractors, as applicable by State licensing law.
D. Bidders are solely responsible for ensuring that bids are received by the time and at the place identified for receipt of bids. The bid opening time shall be established by the timepiece of the Owner’s representative. Bids received late will be returned unopened.

E. A bid sent by mail or courier shall be enclosed in an envelope clearly marked "Bid Envelope Enclosed".

1.09 MODIFICATION AND WITHDRAWAL PRIOR TO CLOSE OF BIDDING

A. Modification: Bids, once submitted, may be modified before the scheduled opening time only upon receipt of a written modification signed by a person legally authorized to bind Bidder to contract. Modification to a bid may be made as an “Add” or “Deduct” only. Modification to bid may be written on the Bid Envelope with the signature of an authorized representative of the Bidder also written on the Bid Envelope. Modification shall indicate only the amount of change, clearly identified as an “Add” or “Deduct”, and not indicate either the prior or resulting bid amount.

B. Withdrawal: Bids, once submitted, may be withdrawn before the scheduled opening time only upon receipt of a written withdrawal request signed by a person legally authorized to bind Bidder to contract.

1.10 POST-BID WITHDRAWAL OF BID FROM CONSIDERATION DUE TO MISTAKE

A request to withdraw a bid due to a mistake shall follow the Policy and Procedure of the State Building Commission. In addition to the requirements therein, such requests shall be delivered in writing to the Owner not later than twenty-four hours after the time fixed for receipt and opening of bids.

1.11 CONSIDERATION OF BIDS

A. To be considered, bids shall be made in accordance with these Instructions to Bidders. Failure to comply with these requirements may cause bid to be rejected.

B. The Owner reserves right to: reject Unit Prices proposed in a bid without invalidating other portions of bid; reject a bid which does not provide all required Unit Prices; waive informalities; and, reject any or all bids.

C. It is Owner’s intent to award contract based upon lowest evaluated responsive bid submitted by responsible Bidder for Base Bid plus Alternates (if any) taken in order up to, but not to exceed the Bid Target. If the Base Bid of all bidders exceeds the established Bid Target, the low Bidder is determined by the lowest Base Bid submitted by a responsible Bidder irrespective of any Alternates (if any) bid. When Alternates are included in bidding, Bid Target will be announced at bid opening prior to opening bids. Alternates may be accepted or rejected at Owner's discretion, provided that final combination of Base Bid and accepted Alternates does not change low Bidder as established by above method.

D. In the event of tie bids, preference will be given to in-State bidder over out-of-State bidder; and, if a tie still exists, successful Bidder will be determined by chance, e.g. a coin toss.

1.12 POST-BID INFORMATION

Each Bidder shall be prepared, if requested by Owner or Designer, to present, within ten days of the request, evidence of experience, qualifications, and financial ability to carry out the terms of the contract.
1.13 BONDS

A. If the initial Contract Sum as awarded exceeds $100,000, the successful Bidder shall provide Contract Bond in an amount of 100 percent of Contract Sum and in accordance with the requirements and form exhibited as Section 00 61 13.

B. The successful Bidder shall furnish, if applicable, a Three Year Roof Bond in an amount stipulated on the Bid Form and in accordance with the requirements and the form exhibited as Section 00 61 43.

1.14 EXECUTION OF THE CONTRACT

A. If a Bidder is presented the written Agreement form for signing, then that Bidder shall deliver to the Owner, within ten calendar days after presentation, the required number of counterparts of the signed Agreement Form, Contract Bond, Roof Bond (if required), and certificates of insurance, ACH Credits Form, and W-9 federal tax form.

B. Failure of the Bidder to return the Agreement as stipulated above shall entitle the Owner to require forfeiture of Bid Security and to proceed with award to the next lowest responsive Bidder.

1.15 AWARD OF THE CONTRACT

Presentation of Agreement form by Owner to Bidder for signature does not constitute award of Contract. Contract shall not be considered awarded until Bidder has received a fully executed Agreement.

1.16 DIVERSITY PARTICIPATION

A. It is the express desire of the Owner and the State Building Commission to include an emphasis on diversity in its contractual relationships with contractors for the construction, demolition or renovation of State projects under jurisdiction of the Commission. The Commission acknowledges that firms who demonstrate and embrace diversity within their programs and policies are assisting the State in achieving its goals in building a more reflective marketplace of the community within this State.

B. It is a requirement of all successful Bidders or proposers on projects under the jurisdiction of the State Building Commission that they report to the State the names and amounts of contracts entered into with diversity-owned businesses on their contract with the State in order for the State to collect data on such participation.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
SECTION 00 21 13.1 – SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

PART 1 - GENERAL

1.1 EXISTING BUILDING / SITE ACCESS

A. Access to the existing building is available to prospective bidders by appointment. Contact the following personnel at ETSU to make arrangements for site visits:

1. Chuck Milam
   Director of Construction
   ETSU Planning, Design, and Construction
   MilamC@mail.ETSU.edu
   (423) 439-7762
   (423) 946-2174 Cell

2. Eddie Phillips
   Construction Manager
   ETSU Planning, Design, and Construction
   PHILLIPSRE@mail.ETSU.edu
   (423) 439-6167
   (423) 747-6229 Cell

END OF SECTION 00 21 13.1
MAP TO THE BID OPENING LOCATION
in Tri-Cities

Bids sent by mail should be directed to the attention of
Lisa Odom, Business Director
ETSU Facilities Management Office
P. O. Box 70653
Johnson City, Tennessee 37614
(423) 439-7768

Bids will be received at:
Facilities Management
1380 Jack Vest Drive
Wilbur Bond Maintenance Building
East Tennessee State University
Johnson City, Tennessee 37614

East Tennessee State University (ETSU) is in
Johnson City, about 1.3 km west-southwest
of the downtown Court House, and about 3.0
km west-southwest of City Hall. The
Physical Plant is about 1.1 km further west-
southwest, on the far side of campus from
downtown.

Suggested route
from I-26 through Johnson City:
• Take I-26 South to Exit 31, which ramps
  right and makes a half-circle.
• Turn left (southwest) onto University
  Parkway. This completes a net right turn
  from I-26. Proceed about 2.5 km.
• Turn left into J. I. Seehorn Drive (formerly
  Southwest Avenue), on the south perimeter
  of ETSU campus. Proceed about 0.8 km.
• Turn right (northwest) at 2nd 4-way Stop
  onto John Robert Bell Drive
  (formerly University Drive).
• Turn left (southwest) at first street, which is
  a divided boulevard known as
  Dossett Drive. Proceed about 0.4 km.
• As Dossett Drive begins to curve right
  around Lucille Clement Hall, continue
  straight into student parking area.
• The Physical Plant
  (Wilbur Bond Maintenance Building) is
  approached via a driveway on the south
  side of the student parking area.

Free Visitor Parking is available in
front of the Physical Plant. Additional
parking is available in an undesignated lot
extending west of the student parking lot.
THIS PAGE INTENTIONALLY LEFT BLANK
PART 1 - GENERAL

1.01 PURPOSE

This section identifies information that was gathered solely for the use of the Designer, is not a Bidding Document, but is available for review by Bidders. Bidders have the entire responsibility for their interpretation and use of this information and shall not rely on the information for preparation of a bid.

1.02 ASBESTOS INVESTIGATION AND REPORT

A. An investigation has been performed at the project site to determine the presence and probable extent of asbestos in the existing building materials.

B. The Owner is not responsible for variations in the actual composition of existing materials. Bidders shall decide for themselves the character of the material to be encountered.

C. The report of the findings of this investigation is on file in the Designer's office, and may be reviewed there by any prospective Bidder of Record. Bidders should call ahead to schedule an appointment. A copy will be provided to any Bidder of Record upon request.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
TO: State of Tennessee FROM BIDDER: ________________________________

FOR:
Project Title: ETSU VA CAMPUS BUILDING 2 FIRST FLOOR RENOVATION
Project SBC No.: 369/005-06-2020

A. The Bidder hereby acknowledges, attests, certifies, warrants, and assures that:
   1. Bidder has received, read and understands the Bidding Documents and this bid is made in accordance therewith.
   2. Bidder has visited the site and become familiar with the local conditions under which the Work is to be performed and has correlated all observations with the requirements of the Bidding Documents.
   3. Documents identified as “Information Available to Bidders” are prepared solely for the Designer’s use in design of this Work and have not been relied upon in the preparation of this bid. The use and interpretation of such information for any purpose is entirely the responsibility of the using party.
   4. Bidder shall not utilize the services of a contractor or subcontractor disqualified from participating in State Building Commission projects.
   5. Bidder shall not knowingly utilize the services of an illegal immigrant in the performance of this Contract and shall not knowingly utilize the services of any subcontractor or consultant who will utilize the services of an illegal immigrant in the performance of this Contract.
   6. In compliance with the Iran Divestment Act the Bidder is not on the list created pursuant to Tennessee Code Annotated (TCA) § 12-12-106 and shall not utilize any subcontractor on that list.
   7. Bid Security, in the amount of five percent (5%) of the total amount of bid, including Alternates, is attached hereto.
   8. A Drug-Free Workplace Affidavit, in the form of Section 00 45 21, is attached hereto.
   9. Failure to complete this Bid Form, provide required attachments, or comply otherwise with instructions to Bidders, may be cause for rejection of bid.
   10. The person who signs this bid on behalf of the Bidder is legally empowered to bind the Bidder to a Contract.
   11. The following statement is (mark the one that is applicable) [ ] True [ ] False:
       The Bidder and/or any of the Bidder’s employees, agents, independent contractors and/or proposed Subcontractors have been convicted of, pled guilty to, or pled nolo contendere to any contract crime involving a public contract.
   12. Bidder has received the following addenda:
       Addendum No. _____ dated ______.
       Addendum No. _____ dated ______.
       Addendum No. _____ dated ______.
       Addendum No. _____ dated ______.
PAGE 2 FROM BIDDER: 

B. The Bidder agrees to:

1. Honor this bid for 45 days following the date of the scheduled opening of bids.
2. Enter into and execute a contract, if presented on the basis of this bid, and to furnish certificates(s) of insurance, bond(s), and other documents related to the contract as required, including, if the initial Contract Sum as awarded exceeds $100,000, the Contract Bond.
3. Accomplish the Work in accordance with the Contract Documents.
4. Furnish Three Year Roof Bond in the form of Section 00 61 43 in the amount of: Roof Bond Not Required.
5. Achieve Substantial Completion of the Work in accordance with the number of calendar days Contract Time set forth, allotted from and including the date stipulated in the Notice to Proceed; and, accept the conditions for Liquidated Damages in the amount set forth per calendar day.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Commencement</th>
<th>Contract Time</th>
<th>Liquidated Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>Notice to Proceed for All Work</td>
<td>270 Days</td>
<td>$300 Per Day</td>
</tr>
<tr>
<td>Not Applicable</td>
<td>Days</td>
<td>$ Per Day</td>
<td></td>
</tr>
<tr>
<td>Not Applicable</td>
<td>Days</td>
<td>$ Per Day</td>
<td></td>
</tr>
<tr>
<td>Not Applicable</td>
<td>Days</td>
<td>$ Per Day</td>
<td></td>
</tr>
</tbody>
</table>

C. BASE BID: The Bidder agrees to complete the Work of the Base Bid for this project for the lump sum of the following amount (In both words and figures. Figures prevail. Words clarify at Owner’s discretion.):

$______________________________ and ________/100ths Dollars

D. ALTERNATES: The Bidder agrees to include Work of the following Alternate(s), as specified in Section 01 23 00 Alternates, for the additional lump sum(s) of the following amount(s) (In both words and figures. Figures prevail. Words clarify at Owner’s discretion.):

ALTERNATE No.1: Floor drains in toilet rooms.

$______________________________ and ________/100ths Dollars

ALTERNATE No. 2: Not Applicable

$______________________________

ALTERNATE No. 3: Not Applicable

$______________________________

ALTERNATE No. 4: Not Applicable

$______________________________
E. UNIT PRICES: The Bidder agrees to include work in the Base Bid and Alternates as specified for the Quantity Allowance of Unit Price Items and propose, subject to Owner acceptance, the following Unit Prices for inclusion in the Agreement as specified in Section 01 22 13 Unit Prices:

Two Unit Price Items:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Unit Price per Unit</th>
<th>Unit</th>
<th>Name, Work Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td></td>
<td>SF</td>
<td>Patch &amp; repair existing plaster ceiling</td>
</tr>
<tr>
<td>A-2</td>
<td></td>
<td>LF</td>
<td>Abatement of pipe insulation containing asbestos</td>
</tr>
</tbody>
</table>

F. BID SUBMITTAL:

This bid is submitted by:

Authorized Signature: ____________________________ Date: ______________

Printed Name, Title: ______________________________

On behalf of:

Bidder Name: ________________________________

Bidder's Address: ________________________________

Bidder's Phone: ________________________________

Bidder's Fax: ________________________________

Bidder's Email: ________________________________

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
STATE OF ___________________
COUNTY OF _________________

The undersigned, principal officer of ________________________________, the Contractor, an employer of five or more employees contracting with ________________________________, the Owner, to provide construction services, hereby states under oath as follows:

1. The undersigned is a principal officer of the Contractor and is duly authorized to execute this Affidavit on behalf of the Contractor.

2. The Contractor submits this Affidavit pursuant to Tennessee Code Annotated (TCA) § 50-9-113, which requires each employer with five or more employees receiving pay who contracts with the state to provide construction services to submit an affidavit stating that such employer has a drug-free workplace program that complies with TCA Title 50, Chapter 9.

3. The Company is in compliance with TCA § 50-9-113.

Further affiant saith not.

____________________________________________
Principal Officer

STATE OF ___________________
COUNTY OF _________________

Before me personally appeared ___________________________, with whom I am personally acquainted (or proved to me on the basis of satisfactory evidence), and who acknowledged that such person executed the foregoing affidavit for the purposes therein contained.

Witness my hand and seal at office this ____________ day of ___________________, 20____.

________________________________________________
Notary Public

My commission expires:__________________________

END OF AFFIDAVIT
Bid to the State of Tennessee for Project:

Project Title: VA Campus Building 2 First Floor Renovation

SBC Number: 369/005-06-2020

Institution: East Tennessee State University

City/County: Johnson City / Washington County

Project Designer: CLARK NEXSEN

Any blank spaces may cause bid to be unacceptable and rejected.

Provide state contractor license number, expiration date, and classification for Bidder and listed subcontractors as applicable.

Provide all names as used for licensing.

Bidder Identification:

Bidder: ____________________________

Address: ____________________________

Tennessee Contractor License Information: ☐ Or check here if Bidder is unlicensed.

<table>
<thead>
<tr>
<th>License Number</th>
<th>License Classification</th>
<th>Applicable to Project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

License Expiration Date ______________________  Dollar Limit: $ _____________.

Subcontractors to be used on this Project (or Bidder if Bidder is to perform the work):

- If any work, regardless of dollar value, is required for trades below, list subcontractor(s) that will perform that work, or, if Bidder will perform work in that category with Bidder’s own forces, fill in Bidder’s name as subcontractor.
- If no work is required in a subcontractor category, write “None Required”.
- If the monetary amount of a subcontractor’s work is such that no license is required, write “N/A” in the license number column, but still write name.

<table>
<thead>
<tr>
<th>Name</th>
<th>License Number</th>
<th>Expires</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geothermal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVAC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masonry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plumbing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This Bid Envelope approved for public opening ____________________________

Signature of Designer or its representative
Agreement

Between Owner and Contractor

Where the Basis of Payment is a
Stipulated Sum.

AGREEMENT

made as of the <<Number, e.g. “2nd”>> day of <<Month>>
in the year of <<Two Thousand Twenty-One (2021)>>.

BETWEEN THE OWNER:

State of Tennessee, via the Contracting Agency:
<<East Tennessee State University>>
<<P.O. Box 70653>>
<<Johnson City, TN  37614>>

AND THE CONTRACTOR:

<<Contractor Name>>
<<Street or P.O. Box>>
<<City, State, Zip Code>>

ACH Address: <<Street or P.O. Box>>
<<City, State, Zip Code>>

THE PROJECT:

<<SBC #369/005-06-2020>>
<<East Tennessee State University>>
<<VA Campus Building 2 First Floor Renovation>>

THE DESIGNER:

<<CLARK NEXSEN>>
<<210 East Watauga Avenue>>
<<Johnson City, TN  37601>>

THE OWNER AND THE CONTRACTOR AGREE AS SET FORTH BELOW.
ARTICLE 1 – THE WORK AND THE CONTRACT DOCUMENTS

1.1 The Contractor shall perform all the Work required by the Contract Documents for the Project identified on page one.

1.2 The Contract Documents are identified in the Conditions of the Contract (General, Supplementary, and other Conditions). These form the Contract and constitute the entire agreement between the Owner and the Contractor, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. An enumeration of the Contract Documents appears in paragraph 1.4.

1.3 Terms used in this Agreement which are defined in the Conditions of the Contract shall have the meanings designated in those Conditions.

1.4 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated as follows:

1. This Agreement.

<<Continued list of Contract Documents including applicable drawings, project manual, and addenda>>
ARTICLE 2 – TIME OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

2.1 The Work to be performed under this Contract shall be commenced on the date stipulated in the Notice to Proceed; and, subject to authorized adjustments, Substantial Completion shall be achieved in

<<Number of calendar days from and including the date stipulated in the Notice to Proceed>>

2.2 Liquidated Damages, as set forth in the Conditions of the Contract, are

<<Dollar amount per calendar day>>

ARTICLE 3 – CONTRACT SUM

3.1 The Owner shall pay the Contractor in current funds for the performance of the Work, subject to Modifications as provided in the Contract Documents, the Contract Sum of

<<Contract Sum in words>>

($<<Contract Sum in numbers>>)

3.2 The Contract Sum is determined as follows:

<<Listing of base bid and any alternates and total>>

3.3 The following Unit Prices will be used as specified:

<<Listing or statement of none established at initial award>>
This instrument may be executed in one or more counterparts. It shall be fully executed when each party whose signature is required has signed at least one counterpart, even though no one counterpart contains the signatures of all the parties to this instrument. Electronic, scanned or facsimile signatures shall have the same force and effect as original signatures.

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

BY CONTRACTOR:  
Signature:  
Name:  
Title:  
AND BY OWNER:  
State of Tennessee,  
<<East Tennessee State University>>  
By:  
Head of Higher Education Institution  
<<>>  
<<>>  
Approved:  
Head of Financial Office  
<<Name>>  
<<Title>>  
Approved:  
Head of Legal Office  
<<Name>>  
<<Title>>  
Approved:  
Head of State Procurement Agency  
<<Laura Bailey>>  
<<Assistant V.P., Capital Planning for ETSU>>  
Approved:  
State Architect

END OF AGREEMENT FORM for the Project titled:

<<SBC #369/005-06-2020>>  
<<East Tennessee State University>>  
<<VA Campus Building 2 First Floor Renovation>>
Bond No. <<Number>>

TENNESSEE STATE BUILDING COMMISSION STANDARD FORM

Know all men by these presents: that we
  <<Name>>
(hereinafter called the "Principal") and
  <<Name>>
(hereinafter called the "Surety") do hereby acknowledge ourselves indebted and securely bound
and held unto
  State of Tennessee
  <<East Tennessee State University>>
  <<P.O. Box 70653>>
  <<Johnson City, TN 37614>>
(hereinafter called the "Owner"), and in the penal sum of
  <<Amount>>

good and lawful money of the United States of America, for the use and benefit of those entitled
thereunto, for the payment of which, well and truly to be made, we bind ourselves, our heirs, our
administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

But the condition of the foregoing obligation or bond is this:
Whereas, the Owner has engaged the principal for the sum of
  <<Amount>>
to complete the Work of the project titled: VA Campus Building 2 First Floor Renovation

SBC No. 369/005-06-2020

as more fully appears in a written agreement or contract bearing the date of <<Date>>
a copy of which said agreement or contract is by reference hereby made a part thereof, as fully
and to the same extent as if copied in length herein, and it is the desire of the Owner that the
Principal shall assure all undertakings under said agreement or contract and shall assure and
protect all laborers and furnishers of material on said Work both as provided by Tennessee Code
Annotated Sections 4-15-102 (f)(2) and 12-4-201 through 12-4-206, and any and all amendments
thereto, and shall assure the prompt payment of claims as provided by Tennessee Code
Annotated Sections 12-4-207 through 12-4-208, and any and all amendments thereto. The
Principal shall also comply with provisions of Tennessee Code Annotated Sections 12-4-401
through 12-4-415, and any and all amendments thereto, pertaining to the payment of the
prevailing wage rate.
Now, therefore, if the Principal shall fully and faithfully perform all undertakings and obligations under the contract hereinbefore referred to and shall fully indemnify and hold harmless the Owner from all costs and damage whatsoever which it may suffer by reason of any failure on the part of the Principal to do so, and shall fully reimburse and repay the Owner any and all outlay and expense which it may incur in making good any such default, and shall fully pay for all of the labor, material and work used by the Principal and any immediate or remote sub-contractor or furnisher of material under him in the performance of said contract, in lawful money of the United States, as the same shall become due, then this obligation or bond shall be null and void, otherwise to remain in full force and effect.

And for value received, it is therefore stipulated and agreed that no change, extension of time, alteration or addition to the terms of the contract or to the Work to be performed thereunder or to the specifications accompanying the same shall in any wise affect the obligation under this bond, and notice is hereby waived of any such change, extension of time, alteration or addition to the terms of the contract or to the Work or to the specifications.

In witness whereof the Principal has hereunto affixed its signature and Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this <<Day number>> day of <<Month>>, 2021.

Executed in <<Number>> counterparts.

Witness:

<<Name of Principal>>  
(Name of Principal)

<<Name of Surety>>  
(Name of Surety)

<<Authorized Signature>>  
(Signature of Attorney-in-fact)

<<Name of Signatory>>  
(Name of Signatory)

<<Name of Attorney-in-fact>>  
(Name of Attorney-in fact)

<<License Number>>  
(Tennessee license number of Agent or Attorney-in-fact)

<<Title of Signatory>>  
(Title of signatory)

Surety Company issuing bond shall be licensed to transact business in State of Tennessee by Tennessee Department of Commerce and Insurance. Bonds shall have certified and current Power-of-Attorney for the Surety's Attorney-in-Fact attached. Attorney-in-Fact who executes bond on behalf of Surety shall be licensed by the State of Tennessee, and shall affix license number to bond; or, countersignature by a licensed agent of the State of Tennessee, and the agent's license number, shall be affixed to the bond in addition to the signature of the Attorney-in-Fact.

END OF SECTION
General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

Section 00.72.13 of all General Work of the Owner as of April 2019

THE OWNER:
(Name, legal status and address)
East Tennessee State University

THE ARCHITECT/DESIGNER:
(Name, legal status and address)

TABLE OF ARTICLES

1 GENERAL PROVISIONS
2 OWNER
3 CONTRACTOR
4 ARCHITECT/DESIGNER
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
15 CLAIMS AND DISPUTES
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, 15.1.1, 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's-Designer's, Definition of
4.1.1
Architect's-Designer's, 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's-Designer's, 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-Designer's, Additional Services and
Expenses
2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4
Architect's-Designer's, Administration of the Contract
3.1.3, 3.7.4, 15.2, 9.4.1, 9.5

Architect's-Designer's Approvals
2.5, 3.1.3, 3.5, 3.10.2, 4.2.7
Architect's-Designer's Authority to Reject Work
3.5, 4.2.6, 12.1.2, 12.2.1
Architect's-Designer's Copyright
1.1.7, 1.5
Architect's-Designer'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-Designer'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-Designer's Instructions
3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2
Architect's-Designer's Interpretations
4.2.11, 4.2.12
Architect's-Designer's, Project Representative
4.2.10
Architect's-Designer'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, 3.12.1, 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-Designer'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-Designer's, Representations
9.4.2, 9.5.1, 9.10.1
Architect's-Designer'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

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 08:27:31 CT on 04/02/2019 under Order
Number: 77478777912 which expires on 04/27/2019, and is not for resale.

User Notes:
(1936430530)
Certificate of Substantial Completion
9.8.3, 9.8.4, 9.8.5
Certificates for Payment
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, 14.11.1.3, 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 and Disputes, Resolution of
15.2
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
Commissioning Consultant
3.10.5
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, 3.10.10, 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 Bond
11.4
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, 7.3.10, 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, 12.12,
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
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/Designer
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
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
Damage, 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/Designer
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, 1.2.1.1, 3.1.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1.1, 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

Direct Personnel Expense (DPE)
7.3.4.2

Disputes
6.3, 7.3.9, 15.1, 15.2

Diversity-Owned Businesses, Participation of
3.20

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

Init.


User Notes:
Emergencies
10.4, 14.11.1, 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
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
Financial Records
3.2.1
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
Illegal Immigrants, Prohibition of
3.4.5
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
4.4.8
Initial Decision-Maker, Decisions
14.2.4, 15.1.4.2, 15.2.1.1, 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, 15.2.1.1, 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, Boiler and Machinery
11.3.2
Insurance, Contractor’s Liability
11.1
Insurance, Effective Date of
8.2.2, 14.4.2
Insurance, Loss of Use
11.3.3
Insurance, Owner’s Liability
11.2
Insurance, Property
10.2.5, 11.2.1, 11.4, 11.5, 11.3
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, 13.1.1

Limitations of Time
2.1.2, 2.2.5, 2.3.2, 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

Liquified Damages
9.12
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
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, Incomplete or 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

Non-Discrimination in Employment
3.4.6
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

Overhead and Profit
7.3.11

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 Representatives, Relations with
3.19
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 OF
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

Project Representatives
4.2.10

Project Manual
1.1.9

Property Insurance
10.2.5, 11.2

Proposal Requirements
1.1.1

PROTECTION OF PERSONS AND PROPERTY
10

Provide or Provided
1.1.10

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, 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/Designer
3.10.1, 3.10.2, 3.11, 3.12, 4.2.5, 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

Scheduling Assistance
3.10.4

Separate Contracts and Contractors
1.1.4, 3.1.2.5, 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/Designer'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

AIA Document A201™ – 2017. Copyright © 1911, 1915, 1918, 1926, 1937, 1951, 1958, 1961, 1953, 1956, 1970, 1976, 1979, 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 08:27:31 CT on 04/02/2019 under Order No. 7747877912 which expires on 04/27/2019, and is not for resale.

User Notes:
Specifications
1.1.1, 1.1.6, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14
State Prevailing Wage
3.4.7
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, 40.2.4
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
Subcontracts
3.4.9
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, 9.9.1, 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, Designer
2.3.3
Substitutions of Materials
3.3.4, 3.5, 7.3.8
Sub-subcontractor, Definition of
5.1.2
Subsurface Conditions
3.7.4
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, Designer
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/Designer
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
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-Designer. 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-Designer or the Architect’s Designer’s consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect-Designer or the Architect’s Designer’s consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect-Designer shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect’s duties. Designer’s duties.

§ 1.1.2.1  Presentation by Owner of an unexecuted Agreement or Modification does not constitute a commitment by Owner to execute the subject document and does not provide Owner authorization to any person or entity to proceed as if document will be executed.

§ 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. The Project is identified in the first page of the Agreement with an Owner’s project number in the format of 999/999-99-9999. This project number may differ from the number as used on other Contract Documents. This Owner’s project number is to be shown in all correspondence related to the Project.

§ 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-Designer and the Architect’s Designer’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. Designer.
§ 1.1.9 Project Manual
The Project Manual is a volume or set that may include portions of the Contract Documents and other documents.

§ 1.1.10 Provide or Provided
"Provide" or "Provided" as used in Contract Documents includes furnishing and installing a thing, product, system or the like.

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

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

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

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

§ 1.2.4 Within the Specifications, the sections of Division One (01) are General Requirements, and apply to all sections of the Specifications.

§ 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-Designer and the Architect-Designer's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, except the design and the Contract Documents, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The design and the Contract Documents are property of the State of Tennessee, and may be used again only for the benefit of the State and on authority of the State Building Commission (SBC). The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Service, the design, or the Contract Documents. 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, Service, the design, or the Contract Documents 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, Service, the design, or the Contract Documents 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. Owner with respect to the design and the

Init. /

User Notes:


(1936349530)
Contract Documents, and the Designer and the Designer's consultants with respect to the Instruments of Service other than the design and the Contract Documents.

§ 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 development, use, transmission, and exchange 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 Exidit, to establish the protocols for the development, use, transmission, and exchange of digital data form.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™-2013: Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G203™-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-Designer 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. Public construction projects are not subject to mechanic's liens in Tennessee. The remedy afforded to laborers and furnishers of material on State projects is referenced in Section 15.2.8.

§ 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. The SBC project number constitutes verification that funding has been established as a matter of public record.

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

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

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

§ 2.3 Information and Services Required of the Owner

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

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number. "Designer" is the licensed prime design professional or firm lawfully practicing architecture, landscape architecture, or engineering, identified in Bidding Documents and Agreement form for project, or the authorized representative thereof.

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

§ 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. The Contractor will be furnished, free of charge, such copies of Contract Documents as are reasonably necessary for execution of the Work.

§ 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 Owner 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. § 2.5.1 If Contractor defaults or neglects to carry out the Work in accordance with Contract Documents and fails within a ten-day period after receipt of written 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 deficiencies.

§ 2.5.2 If the Contractor fails to complete the Work in accordance with the time limit stipulated in the Certificate of Substantial Completion, then Owner may take over the completion of Work without advance notice to Contractor and without prejudice to any other remedy that Owner may have.

§ 2.5.3 In such cases as described in Sections 2.5.1 and 2.5.2, an appropriate modification will be issued deducting from the Contract Sum the reasonable cost of correcting such deficiencies or completing such Work, regardless of whether Owner actually undertakes completing such Work, in which case the deduction shall be based on the Designer's estimate in accordance with Section 7.3.7, including Owner's expenses and compensation for the Designer's additional services made necessary by such default, neglect, or failure. Such action by the Owner and amounts charged to Contractor are both subject to prior approval of the Designer. If the unpaid balance of the Contract Sum is not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

§ 2.5.4 In the case of a Contract Sum based upon a Guaranteed Maximum Price that includes a GMP Contingency, the unused GMP Contingency shall not be included in the calculation required by Section 2.5.3 of unpaid balance of the Contract Sum, and the reduction in the Contract Sum shall not be applied to the GMP Contingency.

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 term "Contractor" means the Contractor or the Contractor's authorized representative. When the Agreement is a Construction Services Agreement between the Owner and a Construction Manager/General Contractor, the term "Contractor" means Construction Manager/General Contractor or its 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-Designer in the Architect's-Designer's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.1.4 At the time of bid and award, Contractor shall not be currently disqualified from participating in State construction projects under the supervision of the SBC. Such disqualification extends to succeeding or related corporations, partnerships, joint ventures, and other business organizations having substantial factual or legal connections, continuity, or identity with those that have been disqualified.
§ 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. The Designer may require prior to proceeding with the Work. 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. Contractor shall not perform construction activity when Contractor knows, in exercise of reasonable diligence, that the activity involves error, inconsistency, or omission in 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-Designer may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect-Designer 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 with reasonable diligence. If the Contractor performs those obligations with reasonable diligence, the Contractor shall not be liable to the Owner or Architect-Designer 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 job site safety thereof and shall be solely responsible for the job site safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect-Designer, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect-Designer shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect-Designer objects to the Contractor’s proposed alternative, the Contractor shall perform the Work that the Designer accepted and the Contractor approved 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. Contractor shall receive neither material, equipment, labor, nor services from one who submitted a competing general bid for the same contract and subsequently withdrew, reneged, or otherwise failed to enter into the contract.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect-Designer in accordance with Section 3.12.8 or ordered by the Architect-Designer in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect-Designer and in accordance with a Change Order or Construction Change Directive. Specified materials, equipment, and systems are essential elements of the Contract. If Contractor desires to use another material, equipment, or system in lieu thereof, Contractor shall request approval in writing and shall submit samples and data, including an estimate of difference in cost, as required for Designer’s consideration. No substitution shall be made without approval in writing from Designer. Owner will be final judge of acceptability of substitution.

§ 3.4.2.1 Not later than 21 days after award of contract, Contractor shall provide a list showing names of manufacturers proposed for each specified project, and applicable name of installer, whether Contractor or subcontractor. Designer will within 14 days reply in writing to Contractor stating whether Owner or Designer, after due investigation, has reasonable objection to any such manufacturer or installer. If adequate data on proposed manufacturer or installer is not available, designer may state that action will be deferred until Contractor provides further data. Contractor shall not make use of a manufacturer, or installer to which Owner or Designer has reasonably objected. Contractor shall receive appropriate adjustment in Contract Sum, Contract Time, or both for making such change unless objection was based on failure of manufacturer or installer to meet requirements of Contract Documents, in which case neither Contract Sum nor Contract Time shall be adjusted. Failure to object to a manufacturer shall not constitute waiver of requirements of Contract Documents. Projects furnished by listed Contractor’s manufacturers must conform to requirements of Contract Documents.

§ 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.

§ 3.4.4 Contractor shall disclose existence and extent of financial interests, whether direct or indirect, which Contractor has in proposed subcontractors and material suppliers.

§ 3.4.5 Prohibition of Illegal Immigrants

§ 3.4.5.1 The requirements of Public Acts of 2006, Chapter Number 878, of the State of Tennessee, addressing the use of illegal immigrants in the performance of any contract to supply goods or services to the State of Tennessee, shall be material provision of this Contract, a breach of which shall be grounds for monetary and other penalties, including termination of this Contract.

§ 3.4.5.2 The Contractor by entering into this contract attests, certifies, warrants, and assures that the Contractor shall not knowingly utilize the services of an illegal immigrant in the performance of this Contract and shall not knowingly utilize the services of any subcontractor or consultant who will utilize the services of any illegal immigrant in the performance of this Contract.

§ 3.4.5.3 The Contractor understands and agrees that failure to comply with this section will be subject to the sanctions of Public Chapter 878 of 2006 for acts or omissions occurring after its effective date. This law provides for the prohibition of a Contractor from contracting with, or submitting an offer, proposal, or bid to contract with the State of Tennessee to supply goods or services for a period of one year after a Contractor is discovered to have knowingly used the services of illegal immigrants during the performance of this Contract.

§ 3.4.5.4 For purposes of this Contract, “illegal immigrant” shall be defined as any person who is not either a United States citizen, a lawful permanent resident, or a person whose physical presence in the United States is authorized or allowed by the Department of Homeland Security and who, under Federal immigration laws and/or regulations, is authorized to be employed in the U.S. or is otherwise authorized to provide services under the Contract.
§ 3.4.6 Non-Discrimination in Employment
§ 3.4.6.1 Contractor shall not discriminate against any employee nor applicant for employment because of race, creed, color, religion, sex, age, or national origin as defined in Tennessee Code Annotated (TCA) § 4-21-401, et seq., nor because of handicap, in accordance with TCA § 8-50-103.

§ 3.4.6.2 Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to handicap, race, creed, color, religion, sex, age, or national origin, including but not limited to practices in recruitment, recruitment advertising, employment, selection for training or apprenticeship, rates of pay or other forms of compensation, upgrading, demotion, transfer, layoff, or termination.

§ 3.4.6.3 Contractor shall post in conspicuous places, available to employees and applicants for employment, notices setting forth these policies of non-discrimination.

§ 3.4.6.4 Solicitations or advertisements for employees placed by or in behalf of Contractor shall state that qualified applicants shall receive consideration for employment without regard to handicap, race, creed, color, religion, sex, age, or national origin.

§ 3.4.7 State Prevailing Wage
§ 3.4.7.1 On contracts determined by the Department of Labor and Workforce Development to be "Highway Construction", Contractor is required to comply with policies, conditions and rules of the Tennessee Department of Labor pursuant to TCA §12-4-401, et seq., and pay prevailing highway wage scale to laborers and mechanics employed on the Work or designated portion thereof, as set forth in said rules, policies, and statute, and to furnish weekly payrolls with the decision number noted on each to the Tennessee Department of Labor and Workforce Development.

§ 3.4.7.2 Owner and Designer shall have endeavored to provide current state highway prevailing wage decision and rate scale as an attachment to this section; however, their failure to do so shall not relieve Contractor of responsibility to comply with the requirement. If state highway prevailing wage decision and rate scale applicable to Project changes during the course of Project, or differs from rate scale provided in Contract Documents, there shall be an equitable adjustment of Contract Sum.

§ 3.4.7.3 When a federal wage scale applies to the Project, it will also be included in the Contract Documents, and the Contractor shall pay not less than the rates set forth therein; and so, shall pay the higher of the state rate and the federal rate if a labor classification exists in both wage scales applicable to the same worker.

§ 3.4.8 Payrolls and Basic Records
§ 3.4.8.1 Contractor and its subcontractors shall maintain payrolls and basic payroll records for all laborers and mechanics working on the contract during the contract and shall make them available to the government until 3 years after contract completion. Records shall contain the name and address of each employee, social security number, labor classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. If federal wage rates and record-keeping apply, the records need not duplicate those required for federal compliance.

§ 3.4.8.2 Contractor and its subcontractors shall allow authorized representatives of the government to inspect, copy, or transcribe records maintained these requirements, and shall allow authorized representatives of the government to interview employees in the workplace during working hours.

§ 3.4.9 Subcontracts
Contractor shall insert these provisions in subcontracts and require subcontractors to include these provisions in any lower tier subcontractors. Contractor shall be responsible for compliance with the provisions set forth herein by direct subcontractors and lower tier subcontractors.

§ 3.5 Warranty
§ 3.5.1 The Contractor warrants to the Owner and Architect/Designer 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 defects. 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.

§ 3.6 Taxes
§ 3.6.1 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.

§ 3.6.2 If the State of Tennessee enacts, after bids are received or negotiations concluded, a change in sales, consumer, use, or similar state tax for the Work or a portion thereof provided by the Contractor, the Contract Sum shall be accordingly adjusted by appropriate modification or the Owner may make other lawful provision to mitigate the change.

§ 3.6.3 Neither Contract Sum nor Contract Time shall be adjusted for impacts resulting from a change in a tax by a governmental body other than the State of Tennessee, regardless of when the tax is enacted or goes 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, except as provided in Section 3.7.3, 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, except as provided in this section, 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. The Owner is an agency of state government, and as such has sovereign immunity from the laws, ordinances, rules, regulations, and lawful orders of local governments within the state; however, the Contractor shall obtain all normal permits whenever possible as if the Owner had no such immunity. If a delay or denial in securing a local permit occurs, the Contractor shall continue the Work, inform the Designer and the Owner of the situation, propose corrective measures, and continue to pursue the customary permits.

§ 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 taking into account that unless otherwise stipulated in Contract Documents, excavations and other subsurface construction activity shall be considered unclassified down to design depth, regardless of substrate and abandoned or inactive infrastructure, 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. The Architect shall 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 makes no adjustment in the Work,
Contract Sum and/or Contract Time. If the Designer 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/Designer shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect/Designer’s determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect/Designer. 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 by Modification. The amount of the Change Order Modification shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 (2) changes in Contractor’s costs under Section 3.8.2.2; Section 3.8.2.2; and
   .4 Contractor shall monitor the costs included in allowances, and shall not incur excess costs without first obtaining a Modification adjusting the allowance sufficient for the excess.

§ 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 and designate a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. Work through final inspection. 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/Designer 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 Designer’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-Designer's approval. The Architect-Designer'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-Designer reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

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

3.10.4 Scheduling Assistance
Owner may provide the Scheduling Assistance. If provided, such services will be set forth in the specifications of Progress Schedules.

§ 3.10.5 Commissioning Consultant
Owner may provide the services of a Commissioning Consultant, either as a consultant engaged by the Owner, or as Subcontractor under a specified allowance and selected by the Owner. If provided, such services will be set forth in the Specifications. The Contractor retains full responsibility for compliance with the Contract Documents. Contractor shall fully cooperate in commissioning, and shall require the necessary forces assisting the Contractor to likewise cooperate fully. If commissioning activities are included in the Work, they shall not be a cause for delay or cost claims.

§ 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-Designer and Owner, and delivered to the Architect-Designer 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-Designer is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect-Designer 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-Designer without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect-Designer, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect-Designer 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-Designer 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, so prior to providing that which is the subject of the submittal, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. If a portion of Work demonstrated by a submittal deviates from the requirements of the contract Documents, the Contractor shall specifically identify the deviation and its difference in cost as part of the submittal.

§ 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-Designer.

§ 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-Designer’s approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect-Designer of such deviation and its difference in cost at the time of submittal and (1) the Architect-Designer 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-Designer’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-Designer on previous submittals. In the absence of such notice, the Architect-Designer’s approval of a resubmission shall not apply to such revisions.

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

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect Designer 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-Designer. The Owner and the Architect-Designer 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-Designer 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-Designer at the time and in the form specified by the Architect-Designer.

§ 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-Designer with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights
The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, indemnify and hold harmless the Owner, Designer, Designer's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of or resulting from alleged infringement of copyrights and patent rights, 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-Designer. 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-Designer.

§ 3.18 Indemnification
§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect-Designer's consultants, and agents and employees of any of them the Owner 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, including loss of use resulting therefrom (other than the Work itself), but only to the extent caused by the willful or 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. Contractor agrees to indemnify the Designer and Designer's consultants based on the willful or negligent acts or omissions of the Contractor, except that Contractor shall not indemnify the Designer and Designer's consultants based on design mistakes and errors or omissions.

§ 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
§ 3.19 Relations with Owner’s Representatives
§ 3.19.1 Contractor, subcontractors, material suppliers, and sub-subcontractors shall neither offer nor give a product, service, payment, negotiable instrument, gift, gratuity, or other compensation in connection with this project to a representative or employee of the State of Tennessee, the Designer, or the Designer’s consultants without Owner’s consent. Evidence of a violation of this requirement may be cause for termination of this Contract.

§ 3.20 Participation of Diversity-Owned Businesses
§ 3.20.1 It is the express desire of the State Building Commission to include an emphasis on diversity in its contractual relationships with contractors for the construction, demolition or renovation of State projects under the jurisdiction of the Commission. Refer to Item 5 in the State Building Commission Policy.

§ 3.20.2 To the extent that the Contractor or a subcontractor is a Diversity-Owned Business, the Contractor shall report to the State its own status in this regard and the names and amounts of contracts entered into with Diversity-owned Businesses on the State projects in order for the State to collect data on such participation.

§ 3.21 Financial Records
§ 3.21.1 The Contractor shall maintain documentation for all charges under this Contract. The books, records, and documents of the Contractor, insofar as they relate to work performed or money received under this contract, shall be maintained for a period of five (5) full years from the date of the final payment and shall be subject to audit at any reasonable time and upon reasonable notice by the State, the Comptroller of the Treasury, or their duly appointed representatives. The financial statements shall be prepared in accordance with generally accepted accounting principles.

ARTICLE 4 - DESIGNER
§ 4.1 General
§ 4.1.1 The Architect-Designer 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-Designer as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect-Designer. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract
§ 4.2.1 The Architect-Designer 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 (1) during construction, (2) until final payment is due, and (3) at the Owner’s request during the one-year period for correction of Work described in Section 12.2. The Designer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect-Designer will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, (1) to become generally familiar with the progress and quality of the portion of the Work completed, (2) endeavor to guard the Owner against defects and deficiencies in the Work, and (3) 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-Designer will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect-Designer 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 which are solely the Contractor’s rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect-Designer 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-Designer will not be responsible for the Contractor’s failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect-Designer will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.
§ 4.2.4 Communications
The Owner and Contractor shall include the Architect-Designer in all communications that relate to or affect the Architect-Designer’s services or professional responsibilities. The Owner shall promptly notify the Architect-Designer of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect-Designer’s consultants shall be through the Architect-Designer. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner, Owner or the Designer. The Contract Documents may specify other communication protocols.

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

§ 4.2.6 The Architect-Designer has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect-Designer considers it necessary or advisable, the Architect-Designer 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-Designer 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-Designer to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect-Designer 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 checking for compliance with the requirements and conformance with the intent of the Contract Documents, The Architect’s action will be taken in accordance with the submittal schedule approved by the Architect-Designer or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect’s 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 assist the Owner in preparing 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-Designer agree, the Architect-Designer will provide one or more Project representatives to assist in carrying out the Architect-Designer’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-Designer 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-Designer’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-Designer 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-Designer 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 in accordance with a reasonable and professional standard of care.

§ 4.2.13 The Architect-Designer’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-Designer will review and respond to requests for information about the Contract Documents. The Architect-Designer’s response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness within 14 days. If appropriate, the Architect-Designer 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 within 21 days after award of the Contract, shall notify the Owner and Architect-Designer 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-Designer may notify the Contractor whether the Owner or the Architect-Designer (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect-Designer to provide notice within the 14-day period shall constitute notice of no reasonable objection. No construction activity shall be commenced by a person or entity in question until all objections have been resolved. If required, Contractor shall furnish evidence satisfactory to Designer, showing each proposed Subcontractor is competent to execute work covered by the subcontract. Subcontractors identified as part of Contractor’s bid for this Project shall be used in the capacity listed, unless otherwise approved by the Owner in accordance with State Building Commission policy.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect-Designer 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-Designer 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 Designer has no reasonable objection.

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

§ 5.2.5 Contractor shall not award subcontract to one who submitted a competing general bid for the same Contract and subsequently withdrew, reneged, or otherwise failed to enter into contract.

§ 5.2.6 Contractor shall not allow work under the Contract to be performed contrary to the requirements of Section 3.4.5 nor by a Contractor or Subcontractor that has been disqualified from participating in State construction projects under the supervision of the State Building Commission. Such disqualification extends to succeeding or related
corporations, partnerships, joint ventures, and other business organizations having substantial factual or legal connections, continuity, or identity with those that have been disqualified. If such a participant is discovered, Contractor shall immediately discontinue the participation and provide a suitable substitute at no additional cost to the Owner, and provide documentation to the Owner of the action taken to comply with this requirement.

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

§ 5.4 Contingent Assignment of Subcontracts
§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that
1. assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
2. assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

Assignment is at the option of Owner, and creates no duty or obligation upon Owner to exercise this option, nor is any right created for any subcontractor to expect or rely upon such assignment. 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

Init. / 26

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 08:27:31 CT on 04/02/2019 under Order No.7747787912 which expires on 04/27/2019, and is not for resale.

User Notes: (1936349530)
§ 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-Designer 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-Designer of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner’s or Separate Contractor’s completed or partially completed construction is fit and proper to receive the Contractor’s Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

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

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

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

§ 6.3 Owner’s Right to Clean Up
If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect-Designer 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-Designer. A Construction Change Directive requires agreement by the Owner and Architect-Designer 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-Designer 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-Designer stating their agreement upon all of the following:

1. The change in the Work;
The amount of the adjustment, if any, in the Contract Sum; and that the price includes all eligible overhead and profit, and represents all direct and indirect costs associated with the change; and

The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 Unless otherwise agreed in writing by Owner and Contractor, the method of determining adjustments in Contract Sum shall be by one or more of the methods set forth in Section 7.3.3, and shall be based on reasonable expenditures and savings as set forth in Section 7.3.4.

§ 7.2.3 When the Owner and Contractor agree with a determination made by the Designer concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, the Owner may issue a written approval of the adjustment(s) prior to being recorded in a Change Order. Such approval shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

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

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

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

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

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect-Designer 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 accordance with Section 7.3.11. In such case, and also under Section 7.3.3, the Contractor shall keep and present, in such form as the Architect-Designer 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:

§ 7.3.4.1 Costs for the purpose 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; Direct personnel expense (DPE);
2. Costs of materials, supplies, and equipment, including cost of transportation, thereof, whether incorporated or consumed;
3. Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others; Machinery and equipment costs based on (1) rental costs for rental of machinery and equipment rented from others and (2) costs for machinery and equipment owned by the Contractor limited to not more than eighty percent (80%) of the applicable average rental rate as listed in the current edition of the AED Green Book for Rental Rates and Specifications for Construction Equipment;
4. Costs of premiums for all bonds and insurance, insurance to the extent required by Contract Documents, permit fees, and sales, use, or other similar taxes, directly related to the change; and
5. Costs of supervision and field office personnel directly attributable to the change. Additional DPE of superintendence directly attributable to authorized overtime; and.
Reasonable DPF of project manager and clerical work directly attributable to estimating and coordinating the change.

The following items are "Class I Time-Related Expenses", and shall be considered as costs when Contract Time is extended due to additional work or a Class 1 cause defined in Section 8.3, and solely to the extent directly attributable to extension of time; field offices, sheds, phones/communication devices, sanitary facilities, dumpsters, trash collection and disposal, on-site utilities, drinking items, supplies, cleaning, safety programs, and all other construction facilities, temporary controls and fixtures not specifically required for additional work; costs of superintendent; superintendent’s vehicle; and other general use vehicles, being those requiring a class D, H, or M license, and excluding those requiring a class A, B, or C license, as set forth in the Tennessee Driver Handbook or comparable current successor publication of the Tennessee Department of Safety and Homeland Security. The daily maximum amount allowed for Class 1 Time-Related Expenses shall be calculated as, and equal to four and one-half percent (4.50%) of the original Contract Sum divided by the original Contract Time.

If the Contract Sum is a Guaranteed Maximum Price between the Owner and a Construction Manager / General Contractor, the costs for project manager, clerical work, and Class 1 Time-Related Expenses included by Sections 7.3.4.1.6 and 7.3.4.1.7 and the extra five percent (5%) for the Contractor in Section 7.3.11.1 shall not apply. In such cases, the CM/GC Fee and General Conditions costs shall apply in accordance with the Master Contract provisions for Modifications and Change in GMP.

§ 7.3.4.2 Direct Personnel Expense (DFP)
§ 7.3.4.2.1 Direct personnel expense (DFP) costs delineated in Sections 7.3.4.1.7, 7.3.4.1.5, 7.3.4.1.6, and 7.3.4.1.7 shall be limited to base salary or hourly wage plus a maximum of thirty-nine percent (39%) of base salary or hourly wage, and further limited to a maximum of $55 per hour, including all labor burden.

§ 7.3.4.2.2 If the Contract sum is a Guaranteed Maximum Price between the Owner and a Construction Manager / General Contractor, and the proposal on which the CM/GC Master Contract is based identifies a Labor Burden multiplier as a cost consideration, then the thirty-nine percent (39%) maximum in Section 7.3.7.2.1 shall not apply, and the Labor Burden multiplier provided in the Proposal shall be used.

§ 7.3.4.3 Specifically excluded from costs and included in overhead or general requirements are: corporate, home office, and branch office overhead, rent, mortgage, off-site utilities, project management, and personnel not otherwise mentioned; capital expenses and interest on capital; hand tools; and the items of cost listed in Section 7.3.4.1.7 when Contract Time is not extended due to additional work or a Class 1 clause.

§ 7.3.4.4 To facilitate checking for increases or decreases in the Contract Sum, proposals, shall be accompanied by Contractor’s complete itemization of costs of work including labor, materials and equipment, plus an amount for overhead and profit.

§ 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-Designer 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-Designer. When both additions and credits covering related Work or substitutions are involved in a change, the allowance amount 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 and shall be recorded by preparation and execution of an appropriate Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.3.11 Overhead and Profit
§ 7.3.11.1 The amount recoverable as overhead and profit on costs stipulated in Section 7.3.4 shall be limited to the following:

1. For Contractor performed work, the Contractor shall be entitled to overhead of ten percent (10%) of the cost of the self-performed work (the "Overhead") and profit of five percent (5%) of the sum of the cost of the self-performed work and the Overhead. The Contractor's Overhead of ten percent (10%) is not applied to the Class I Time Related Expenses in § 7.3.4.1.7.

2. For Subcontractor performed work:
   a. The Contractor shall be entitled to profit of five percent (5%) of the sum of all Subcontractor's itemized costs, Subcontractor Overhead, and Subcontractor Profit. The Contractor shall not be entitled to recover any overhead on work performed by a Subcontractor.
   b. The Subcontractor shall be entitled to overhead of ten percent (10%) of its itemized cost ("Subcontractor Overhead") and profit of five percent (5%) of the sum of its itemized cost and the Subcontractor Overhead ("Subcontractor Profit").

3. For Sub-subcontractor performed work, a Subcontractor shall be entitled to profit of five percent (5%) of the sum of all Sub-subcontractor's cost. The Subcontractor shall not be entitled to recover any overhead on work performed by its Sub-subcontractors.

§ 7.3.11.2 When the Contract Sum is a Guaranteed Maximum Price between the Owner and a Construction Manager / General Contractor, the extra five percent (5%) for the Contractor in Section 7.3.11.1 shall not apply. In such cases, the CM/GC Fee shall apply in accordance with the Master Contract provisions for Modifications and Change in GMP.

§ 7.4 Minor Changes in the Work
The Architect-Designer 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-Designer'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-Designer and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect-Designer's order for a minor change without prior notice to the Architect-Designer 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-Designer 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, in accordance with the Agreement.

§ 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, or 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. The basis exists for an extension of time if Contractor is delayed in performing Work, but solely to the extent that delays are unforeseeable, unavoidable, and beyond the control and without fault or negligence, in whole or in part, of Contractor, subcontractors, sub-subcontractors, and suppliers at every tier, and said delays directly impact the Contractor’s ability to achieve Substantial Completion in accordance with the Contract Time requirements, and said delays cannot be made up by reasonable efforts otherwise and said delays stem from the following causes:

§ 8.3.1.1 Class 1 causes: an act or failure to act that is contrary to the Contract Documents on the part of Owner or Designer or an employee of either, or of a separate Contractor employed by Owner, or an injunction against Owner or Owner’s representatives; any impact to the Contractor that requires an adjustment in the Contract Sum and Contract Time.

§ 8.3.1.2 Class 2 causes: abnormal weather, acts of God, riots, civil commotion, acts of War, fire, unavoidable casualties, epidemics, quarantine restrictions, labor disputes, unusual delay in transportation, freight embargoes, or insolvency of subcontractors, sub-subcontractors, or suppliers.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15. If the basis exists for an extension of time under Section 8.3.1, Owner may either:

1. in the case of additional work or a Class 1 cause, assign the Class 1 Time-Related Expenses, defined in Section 7.3.4.1.7, plus the overhead and profit allowed in Section 7.3.11, to a special allowance that can be earned based upon the extent of actual use of the related Time Extension in completion of the Work;

2. accept the reasonable and appropriate time extension as determined by Designer to cover such delay, and in the case of a Class 2 cause, there will be no corresponding adjustment in Contract sum, and the sole recourse of Contractor will be entitlement to time extension as provided by Designer regardless of actual source or cause of delay;

3. order Contractor to accelerate construction activity by working overtime and by adding extra forces in order to overcome such delays, and adjusting the Contract Sum in accordance with Article 7 to compensate Contractor for such directed acceleration; however, direct costs used in determining such compensation shall be limited to properly substantiated and documented premium or overtime labor costs; or

4. employ a combination of the above remedies.

§ 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—Extension of Contract Time due to Class 2 causes shall be applied to the Contract Time prior to the application of Class 1 time.

§ 8.3.4 Neither Owner nor Designer will be obligated or liable to Contractor for, and Contractor hereby expressly waives claims against Owner and Designer on account of damages, costs, expenses, or related impacts which Contractor, subcontractors, sub-subcontractors, suppliers, or other persons may incur as a result of a Class 2 cause.
enumerated in Section 8.3.1. Contractor's sole and exclusive remedy and full compensation in such event shall be extension of Contract Time in accordance with provisions of the Contract Documents. Contractor likewise waives claims of damages, costs, or expenses due to a delay resulting from a Class I cause except and solely to the extent of costs allowed under Section 7.3.4.

§ 8.3.5 Claims relating to time shall be made in accordance with applicable provisions of Article 15 or shall receive no consideration. If monthly Weather Delay Reports are required by the specifications, then claims for time extension based upon weather delays will be denied if a submitted report does not corroborate the Claim or if no report was submitted when it was required, and Contractor waives the right to such claims.

§ 8.3.6 Extensions of time shall be implemented in accordance with Article 7.

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. The Contract Sum is not subject to change due to commodity, equipment, or labor cost fluctuations.

§ 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, subject to limitation and requirements contained in the Contract Documents.

§ 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-Designer 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-Designer. This schedule, unless objected to by the Architect-Designer, 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-Designer and supported by such data to substantiate its accuracy as the Architect-Designer may require; and unless objected to by the Architect-Designer, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect-Designer 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-Designer may 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 except those costs have been included in the Contract Sum and actually incurred. Additional costs, which may be attendant to the off-site storage, are the responsibility of the Contractor, and cannot be claimed by Contractor against Owner.
§ 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, at the time payment is received by the Contractor. 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.

§ 9.3.4 In Applications for Payment, the amount represented as total completed and stored to date shall reflect that portion of the Contract Sum properly allocable to labor, materials, and equipment incorporated in the Work and materials and equipment suitably stored in accordance with Section 9.3.2, and not exceed the Contract Sum less the value of incomplete Work and corrections required. This total completed and stored to date shall not be construed to define completion as determined by Substantial Completion or final completion of the Work according to Sections 9.8, 9.9, or 9.10.

§ 9.3.5 Applications for Payment shall indicate retainage withheld from the total completed and stored to date as follows: five percent (5%) until acceptance of a certificate of Substantial Completion; and, thereafter two percent (2%) until final payment. The resulting amount shall be indicated as the total earned less retainage. Applications that reduce retainage shall be accompanied by Consent of Surety, if a bond was required according to Section 11.4.

§ 9.3.6 Applications for Payment shall indicate the total earned less retainage, and the aggregate of previous payments made subtracted therefrom, and an amount requested.

§ 9.4 Certificates for Payment
§ 9.4.1 The Architect-Designer 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-Designer determines is proper due, and notify the Contractor and Owner of the Architect-Designer'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-Designer'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-Designer to the Owner, based on the Architect-Designer's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect-Designer'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-Designer. However, the issuance of a Certificate for Payment will not be a representation that the Architect-Designer 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-Designer may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect-Designer's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect-Designer is unable to certify payment in the amount of the Application, the Architect-Designer will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect-Designer cannot agree on a revised amount, the Architect-Designer will promptly issue a Certificate for Payment for the amount for which the Architect-Designer is able to make such representations to the Owner. The Architect-Designer 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/Designer’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, Documents, or
8. potential liquidated damages and other unsettled claims.

§ 9.5.2 When either party disputes the Architect’s/Designer’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 any of the reasons for withholding certification are removed, certification will be made for respective amounts previously withheld.

§ 9.5.4 If the Architect/Designer withholds certification for payment under Section 9.5.1, 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/Designer and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments
§ 9.6.1 After the Architect/Designer 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/Designer.
1. Payment is due not later than 45 days after an undisputed Certificate for Payment has been received by the Owner. Owner will endeavor to make payment within 21 days, but shall not be obligated to do so.
2. Based upon Certificates for Payment issued by the Designer, correcting the Application for Payment as appropriate, the Owner shall make progress payments to the Contractor as provided in the Contract Documents.

§ 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, as determined by the Consultant, reflecting the percentages actually retained from payments to the Contractor on account of the percentage of the Work done by such Subcontractor.

§ 9.6.3 The Architect/Designer and Owner, in their discretion, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect/Designer 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/Designer shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

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

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.
§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both; under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision. When Contract Sum meets the statutory threshold, pursuant to TCA § 66-34-104, the Contractor shall comply with the procedures established by the Tennessee State Treasurer and Department of Finance and Administration for establishment of an interest-bearing retainage escrow account.

§ 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, Contractor and the Designer. 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. The Designer may act in accordance with Section 9.5 or the Contractor may furnish acknowledgement of the claim from the Surety satisfactory to the owner to indemnify the Owner in making payment to the Contractor without reduction of the claim.

§ 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 payment is due as established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, currently due as of that date pursuant to the terms of the Contract Documents (including certification by the Designer), then the Contractor may, upon seven additional days' notice to the Owner and Architect,Designer, 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. In order to occupy or utilize the Work for its intended use, Owner must have received from the State Fire Marshal the Certificate of Occupancy, or in the case of renovations the Project Completion Form, and the Owner must have received substantially complete Product Data, Operating and Maintenance Data, orientation, and training, as may be required by specifications.

§ 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-Designer 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-Designer 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-Designer. In such case, the Contractor shall then submit a request for another inspection by the Architect-Designer to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect-Designer 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, the Certificate, subject
to the provisions of Section 9.12.2. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

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

§ 9.9 Partial Occupancy or Use
§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect/Designer 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/Designer.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect/Designer 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/Designer will promptly make such inspection. When the Architect/Designer finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect/Designer will promptly issue a final Certificate for Payment stating that to the best of the Architect/Designer’s knowledge, information and belief, and on the basis of the Architect/Designer’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/Designer’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/Designer (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 shall furnish acknowledgement of the matter from the Surety satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance matter in lieu of such a release or waiver. If such matter 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,so such matter, 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-Designer so confirms, the Owner shall, upon application by the Contractor and certification by the Architect-Designer, 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-Designer 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 not constitute a waiver of Claims by the Owner except those arising from the following:

.1 liens, Claims, security interests, or encumbrances arising out of the Contract Documents and unsettled;
.2 failure of the Work to comply with the requirements of the Contract Documents; Documents, irrespective of when such failure is discovered;
.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, payment, 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.

§ 9.10.6 Final payment constituting the entire unpaid balance of Contract Sum, shall be paid by Owner to Contractor when Work has been completed, the Contract fully performed, and a final Certificate for Payment issued by Designer.

§ 9.10.7 If there is no Contract Bond, the final Certificate may be withheld until the prospect of final payment is advertised once, 30 days prior to issuance of the final payment, for the benefit of those to whom the Contractor may be indebted.

§ 9.11 Method of Payment
§ 9.11.1 Payments to Contractor shall be made through Owner's automated clearing house wire transfer system. Contractor shall have completed an Authorization Agreement for Automatic Deposits ACH Credits Form prior to commencing Work and prior to submitting a first application for payment. At the Owner's option, other payment options may be utilized.

§ 9.11.2 Debit entries to correct errors authorized by the Authorization Agreement for Automatic Deposits ACH Credits Form shall be limited to those errors detected prior to the effective date of the credit entry. The remittance advice shall note that a correcting entry was made. Corrections shall be made within two banking days of the effective date of the original transaction. Other errors detected at a later date shall take the form of a refund, or in some instances, a credit memo if additional payments are to be made.

§ 9.11.3 The Owner reserves the right to deduct from amounts which are or shall become due and payable to Contractor under this or any contract between the parties any amounts which are or shall become due and payable to the State by the Contractor.

§ 9.12 Liquidated Damages
§ 9.12.1 Time being of the essence, Contractor further agrees to accept conditions for Liquidated Damages in the amount set forth in Contract Documents for each calendar day in excess of allotted time for Substantial Completion, or approved extension thereof, parties agreeing that the amount of damages resulting from delay shall be uncertain and difficult to prove, and further agreeing that such Liquidated Damages set forth in the Owner-Contractor Agreement are a reasonable estimate of those damages which could result from delay.

§ 9.12.2 If a portion of the Work is certified Substantially Complete, the amount of Liquidated Damages applicable to the remaining Work may be reduced by Written mutual agreement.

§ 9.12.3 Secondary Liquidated Damages shall be twenty-five percent (25%) of that originally required by the Contract Documents, and shall accrue until such time that Work has been completed and the Contract fully performed if:
1. The time for completion stipulated in the Certificate of Substantial Completion has passed; or, if no such time was stipulated, then 30 calendar days has passed following the certified date of Substantial Completion and:

2. The Contract Time, including approved extensions, plus 30 calendar days, has passed.

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/Designer 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. Owner reserves the right to make repairs to damaged property and deduct all costs from the Contract Sum. 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/Designer.

§ 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 2+14 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.
§ 10.3 Hazardous Materials and Substances
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect-Designer of the condition.

§ 10.3.2 Upon receipt of the Contractor’s notice, pursuant to circumstances described in Section 10.3.1, Owner will have the option to either terminate the contract as provided in Article 14, proceed with Contractor in a mutually agreed plan of action, or as follows: 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-Designer 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-Designer 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-Designer has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect-Designer 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, following claim and modification processes in accordance with Articles 15 and 7, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor’s reasonable additional costs of shutdown, delay, and start-up.

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

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

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

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred. Contractor may file claim under Article 15 for consideration.

§ 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 Liability 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, as required, to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, such insurance required by the Contract Documents as will protect the Contractor and the Owner from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

1. Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
2. Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
4. Claims for damages insured by usual personal injury liability coverage;
5. Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property on or away from the site, including loss of use resulting therefrom;
6. Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
7. Claims for bodily injury or property damage arising out of completed operations; and
8. Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 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 bond from a company or companies, as required, to issue surety bonds in the jurisdiction where the Project is located. Insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until four years after Substantial Completion. Specific lines of coverage and limits of liability provided by the Contractor shall be written in a comprehensive form satisfactory to the Owner in the following minimum requirements:

1. Commercial General Liability, with limits for bodily injury and property damage of
   Each Occurrence $1,000,000
   Annual Aggregate $2,000,000
   and including:
   premises & operations;
   underground, explosion, & collapse;
   products & completed operations;
   contractual;
   independent contractors; and,
   personal injury (employment exclusion deleted).
   The General Aggregate shall apply specifically to this project, using ISO form CG 2503 or the equivalent. The policy will contain a Waiver of Subrogation endorsement in favor of the Owner.

2. The Contractor will maintain a Contractor's Pollution Liability policy with limits of
   Each Occurrence $1,000,000
   Annual Aggregate $2,000,000
   Coverage will commence prior to the beginning of the Work and will be maintained until four years after Substantial Completion. The policy will be written on a primary and non-contributory basis and will name the Owner as an additional insured for both on-going and completed operations. Coverage will apply to all construction operations, transit and disposal of material at non-owned disposal sites performed by or on behalf of the Contractor. The Policy shall not contain coverage exclusions related to asbestos, lead, silica or mold/microbial matter. The policy will contain a Waiver of Subrogation endorsement in favor of the Owner.
3. Commercial Automobile Liability, with combined single limits for bodily injury and property damage of each occurrence $1,000,000 and including owned, hired, and non-owned vehicles; or, if there are no owned vehicles, Contractor may provide written certification of such and provide coverage limited to hired and non-owned vehicles. The policy will be written on a primary and non-contributory basis and will name the Owner as an additional insured, and will contain a Waiver of Subrogation endorsement in favor of the Owner.

4. Workers Compensation and Employer’s Liability, (without restriction as to whether covered by Worker’s Compensation law), with Workers Compensation according to statute, and Employer’s Liability: $500,000 per occurrence for bodily injury, $500,000 per employee for bodily injury by disease and a $500,000 policy limit for bodily injury by disease. The policy will contain a Waiver of Subrogation endorsement in favor of the Owner.

5. If an exposure exists, Aircraft and Watercraft Liability (owned & non-owned), with limits approved by Owner shall be provided.

6. The Contractor will maintain Excess or Umbrella Liability coverage that is as broad or broader than the required Commercial General Liability, Commercial Automobile Liability and Employer’s Liability with minimum limits of $5,000,000 per occurrence, $5,000,000 Annual Aggregate. The Excess or Umbrella policy will be written on a primary and non-contributory basis and will name the Owner as an additional insured.

§ 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. Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to Owner’s execution of the Agreement and thereafter upon renewal or replacement of each required policy of insurance. Certificate(s) of insurance provided to attest to coverage shall specifically cite each element of coverage and not less than limits set forth in Section 11.1.2, as confirmation of complete coverage, and shall identify Contractor, Producer, Insurance Carrier, Project, and certificate holder, and state Producer’s notice requirements as set forth in Section 11.1.4. The term “Commercial General Liability” shall mean all of the coverage listed in Section 11.1.2.a unless specifically noted otherwise in the certificate. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 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. The Contractor and its subcontractors shall cause the commercial general liability, auto, pollution and excess/umbrella coverage required by the Contract Documents to include (1) the Owner, the Designer and the Designer’s consultants as additional insureds on a primary and non-contributory basis for claims caused in whole or in part by the Contractor’s negligent acts or omissions during the Contractor’s operations using ISO Form CG 2010 (07/04); and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor’s negligent acts or omissions during the Contractor’s completed operations, using ISO Form CG 2037 (07/04) edition.

§ 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.

§ 11.1.5 Contractor shall notify Owner in writing of changes in coverage or carrier not later than ten days after notification of Contractor by Producer, or ten days before Contractor makes a change, whichever occurs first. By way of an endorsement to the policy, the Insurer will be required to provide written notice if policies are cancelled or modified before expiration date thereof.

§ 11.1.6 If professional design services or certifications by an appropriately licensed design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, as referenced in Sections 3.12.10.1 and 3.12.10.2, then that professional(s) shall maintain Professional Liability Insurance in the amount of: Each Claim $1,000,000, Annual Aggregate $1,000,000. The Professional Liability Insurance coverage shall be maintained for four years after the date of Substantial Completion of the Project. The Contractor is responsible for requiring that the Professional Liability Insurance is acquired and maintained.

§ 11.2 (Deleted)

§ 11.3 Waivers of Subrogation Property Insurance
§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property. Contractor shall purchase from and maintain, with a company or companies licensed to do business in Tennessee by the

Init. 42

AIA Document A201™ – 2017. Copyright © 1911, 1915, 1618, 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 08:27:31 CT on 04/02/2019 under Order No.7747977912 which expires on 04/27/2019, and is not for resale.

User Notes: (1936349530)
Department of Commerce and Insurance, property insurance written on a builder’s risk “all risk” or equivalent policy form in the amount of the initial Contract Sum plus value of subsequent Contract modifications for the covered project at the site on a replacement cost basis. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall specify the Owner as named insured, and the Contractor, Subcontractors and Sub-subcontractors as insureds under the policy.

§ 11.3.2.1 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 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.

§ 11.3.1.1 Property insurance shall be on an “all-risk” or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, and debris removal and shall cover reasonable compensation for Designer’s services and Contractor’s work required as a result of such insured loss. The policy will be written to include a waiver of subrogation applying to all parties.

§ 11.3.1.2. For Work stored off the site, or in transit, the Contractor shall provide insurance upon such Work to protect the Owner’s Interest.

§ 11.3.1.3. Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or
companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.1.4 Builder’s Risk Insurance (BRI) for the full amount of the Contract Sum, unless the Work consists entirely of hazardous materials abatement or other demolition with no constructive patching or renovating, in which case there will be no BRI.

§ 11.3.1.5 The Contractor will be responsible for maintaining its own insurance for owned, leased and borrowed tools and equipment. The policy will contain a Waiver of Subrogation endorsement in favor of the Owner.

§ 11.3.2 Boiler and Machinery Insurance
The Contractor shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 Loss of Use Insurance
The Owner, at the Owner’s option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner’s property due to fire or other hazards, however caused.

§ 11.3.4 Before an exposure to loss may occur, the Contractor shall file with the Owner a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the Issuing company will endeavor to provide ten days written notice to the Owner should the policy be canceled prior to the expiration date.

§ 11.3.5 A loss insured under the Contractor’s property insurance shall be adjusted by the Contractor as fiduciary and made payable to the Contractor as fiduciary for the insureds. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.6 If after an insured loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor.

§ 11.4 Contract Bond
§ 11.4.1 If the initial Contract Sum as awarded exceeds $100,000, Contractor shall provide Contract Bond, in the amount of one hundred percent (100%) of Contract Sum covering faithful performance of contract and payment of obligations arising thereunder. If a Contract Bond is required, and a Three Year Roof Bond is also stipulated in the Bidding Documents, then the Three Year Roof Bond shall be provided as stipulated. Bond(s) shall be executed on Tennessee State Building Commission Standard Form(s) exhibited in Bidding Documents for project, and subject to provision of Section 11.4.3.

§ 11.4.2 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.

§ 11.4.3 Surety is the person or entity identified as such in a bond and is referred to throughout the Contract Documents as if singular in number. The term “Surety” means the Surety or the Surety’s authorized representative. Surety Company issuing Bond shall be licensed to transact business in Tennessee by Department of Commerce and Insurance, Bonds shall have certified and current Power-of-Attorney for the Surety’s Attorney-in-Fact attached, Attorney-in-Fact who executes bond on behalf of Surety shall be one who is licensed by Tennessee as a resident agent, and shall affix license number to bond; or, countersignature by and license number of a licensed resident agent shall be affixed to the bond in addition to the signature of the Attorney-in-Fact.
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-Designer’s request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect-Designer, be uncovered for the Architect-Designer’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-Designer has not specifically requested in writing to examine prior to its being covered, the Architect-Designer may request in writing 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 and recovering the Work, and the cost of correction, shall be at the Contractor’s expense.

§ 12.2 Correction of Work
§ 12.2.1 Before Substantial Completion
The Contractor shall promptly correct Work rejected by the Architect-Designer 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-Designer’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 of known noncomplying Work 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 noncomplying Work within a reasonable time during that period after receipt of notice from the Owner or Architect-Designer, the Owner may correct it in accordance with Section 2.5. If Three Year Roof Bond has been provided, then with regard to the total roofing system, its installation, and materials, the one year time period hereunder is extended for two additional years for a total period of three years. Until such time as the three years hereunder have expired, Contractor’s obligations hereunder shall be joint and several with Company as defined and set forth in the Roofing System Warranty. For the purpose of Section 12.2.2, all of Company’s actions, whether of omission or commission, pursuant to the Roofing System Warranty are likewise actions of contractor hereunder and shall in no way negate or reduce the responsibilities of Contractor hereunder.

§ 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.

§ 12.2.3 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 and time period of applicable special warranties 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 Incomplete or 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 completion or 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 located.

§ 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 12.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

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

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

§ 13.3.2 No action or failure to act by the Owner, Architect, Designer, 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.

§ 13.3.3 If procedures within the Contract fail to satisfy a Claim against the Owner, further action is to be taken up with the Tennessee Claims Commission, pursuant to TCA § 9-8-101, et seq. Damages recoverable against the State shall be limited expressly to claims awarded by the Commission, or any appellate decision of such claim awarded by the Commission.

§ 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-Designer 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 authority. The Owner shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect-Designer timely notice of when and where tests and inspections are to be made so that the Architect-Designer 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-Designer, 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-Designer...
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-Designer of when and where tests and inspections are to be made so that the Architect-Designer 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-Designer’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-Designer.

§ 13.4.5 If the Architect-Designer is to observe tests, inspections, or approvals required by the Contract Documents, the Architect-Designer 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, past due as stated in Section 9.6.1 in accordance with TCA § 12-4-704 as may from time to time be amended.

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-Designer 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 one hundred percent (100%) 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-Designer, 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 including eligible overhead, profit, and costs as defined in Section 7.3.4 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-Designer, 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-Designer 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 Work, the site, and all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

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

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect’s services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial DecisionMaker, Designer, 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; Work, including materials for which Owner has paid and which are stored off-site; 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 the event 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. Contractor’s sole and exclusive remedy shall
be to receive payment for the reasonable value of the completed portion of Work plus a portion ("P") of the remaining balance of the Contract Sum calculated under the following formula.

"P" = [(Remaining Balance of Contract Sum) x (0.05)] x [(Value of the Work Completed) / (Contract Sum)]

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—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 either party 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—Contract Documents and Section 13.3.3 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 written 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 24–48 days after occurrence of the event giving rise to such Claim or within 24–48 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. If the effect of the condition giving rise to the Claim cannot be fully evaluated, a preliminary notice of pending claim shall be made within the stated time limit subject to further action in a timely manner.

§ 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. The Architect will issue recommendations for change orders and certificates for payment in accordance with its decisions pursuant to Section 15.2.5.

§ 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; written notice as required by the Contract Documents shall be given to the Owner by the Contractor, and written notice received by the Contractor from Owner acknowledging the claim and authorizing construction activity to proceed, before the Contractor shall proceed to execute the construction activity giving rise to the claim; thereafter, the claim shall be addressed under provisions of Section 15.2. Documentation of claims shall conform to the requirements of Article 7.
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. To make Claim for an increase in Contract Time, Contractor shall give written notice as provided herein, and include an estimate of cost, which shall be limited to that allowed by Section 8.3.3, and an explanation of the cause and probable effect on progress of the Work. In the case of a continuing delay, only one Claim is necessary; necessary, and Contractor shall subsequently detail the full scope of the delay.

§ 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 waives Claims against the Owner 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, Contract including but not limited to either party’s termination in accordance with Article 14, principal office expenses, including the compensation of personnel stationed there, at the principal office, and any damages 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 Resolution of Claims and Disputes
§ 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 Claims shall be referred to the Designer for initial decision. An initial decision or other action by the Designer in accordance with Section 15.2.2 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. Claims or action pursuant to remedies provided by law for Claims between Owner and Contractor, unless the Designer fails to timely comply with Section 15.2.2.

§ 15.2.2 The Initial Decision Maker-Designer will review Claims and within ten days of the receipt of a Claim or information preliminary or pursuant to a Claim or modification to a Claim and 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-Designer is unable to resolve the Claim if the Initial Decision Maker-Designer lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker-Designer concludes that, in the Initial Decision Maker-Designer’s sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the designer to resolve the Claim. If Designer approves or rejects the Claim, parties have ten days to request reconsideration based upon additional information, or the decision shall be final. If Designer suggests compromise, parties have ten days to respond. If the Designer declines to resolve the claim, the Owner may, but is not obligated to, take the lead in resolving the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker-Designer 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-Designer in rendering a decision. The Initial Decision Maker-Designer may request the Owner to authorize retention of such persons at the Owner’s expense.

§ 15.2.4 If the Initial Decision Maker-Designer 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-Designer when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker-Designer that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker-Designer 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-Designer will render an initial decision which 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, the provisions in Section 15.2.2, and thereafter to mediation if consented to by both parties, and to remedies as otherwise provided by law.

§ 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. As a matter of law, the State of Tennessee and its property are not subject to mechanic’s and material suppliers liens. Subcontractors, suppliers, and other claimants are protected through the Contract Bond as required by TCA § 12-4-201 et seq., and Section 11.4 of these Conditions. Specific requirements for notice of Claims on the bond are set forth in the TCA § 12-4-205.

§ 15.3 Mediation
The State of Tennessee is not subject to mandatory mediation.

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

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

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

§ 15.4.4 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
The State of Tennessee is not subject to mandatory 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.
Certification of Document's Authenticity
AIA® Document D401™ – 2003

I, ____________, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification at 08:27:31 CT on 04/02/2019 under Order No. 7747877912 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ – 2017, General Conditions of the Contract for Construction, as published by the AIA in its software, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)

(Title)

(Dated)
SECTION 01 10 00 – SUMMARY OF WORK

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. Work under separate contracts.
   4. Access to site.
   5. Coordination with occupants.
   6. Work restrictions.
   7. Specification and Drawing conventions.
   8. Miscellaneous provisions.

B. Related Requirements:
   1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: ETSU VA Campus Building 2 Renovation
   1. Project Location: Building #2 Dogwood Ave.
      VA Medical Center Campus
      Mountain Home, TN 37684

2. Owner: East Tennessee State University

3. Owner's Representative: Mr. Charles Milam

B. Architect: Mr. Chadwick Roberson

C. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

D. 1. Structural Engineering: Lynch Mykins, Bryan Covington, PE
E. Other Owner Consultants: Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Hazardous Materials: S&ME, Ms. Carol Goldinger Ford, has prepared the following portions of the Contract Documents:
   a. Specifications for Removal & Disposal of Asbestos Containing Materials
   b. Hazardous Material Assessment

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Renovation of the first floor of the existing ETSU VA Campus Building #2 and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.


1.6 ACCESS TO SITE

A. General: 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. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

   1. Limits: Confine construction operations to area within Chain Link Construction Fence indicated on sheet AS101.
   2. Driveways, Walkways and Entrances: Keep adjacent driveways and entrances clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations. Contractor shall be responsible for repair or replacement of any building component that is damaged during the construction activities that is to remain. This shall include but not be limited to thermal shock of the building during winter months.

D. 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.

1.7 COORDINATION WITH OCCUPANTS

A. Owner will occupy adjacent site and 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 7 days in advance of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7 a.m. to 6 p.m., Monday through Friday, unless otherwise indicated.

1. Weekend Hours: Weekends are not to be considered a part of normal working hours. Work on Sundays will not be permitted. Work on Saturdays will not be permitted unless authorized during the owner during construction. Contractor would have to provide a written request to the owner and receive written confirmation from the owner.
2. Hours for Utility Shutdowns: Coordinate with Owner by provided 7 days written notice and written confirmation shall be received from the Owner. The Owner reserves the unqualified right to reject proposed times for utility shutdowns. The owner reserves the unqualified right to reject proposed times for utility shutdowns.
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 providing temporary utility services according to requirements indicated:

1. Notify Architect and Owner not less than seven days in advance of proposed utility interruptions.
2. Obtain Architect's and Owner’s written permission before proceeding with utility interruptions.
3. The owner reserves the unqualified right to reject proposed times for utility shutdowns.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Architect and Owner not less than seven days in advance of proposed utility interruptions.
2. Obtain Architect's and Owner’s written permission before proceeding with utility interruptions.
3. The owner reserves the unqualified right to reject proposed times for operations that may result in high levels of noise, vibration, or odors.

E. Restricted Substances: Use of tobacco products, other controlled substances (other than those prescribed by a physician), or firearms is not permitted on the jobsite.

1.9 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. 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 published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00
PART 1 - GENERAL

1.01 REQUIREMENTS
   A. Comply with requirements of the General Conditions of the Contract for Construction.
   B. Designate in construction progress schedule the delivery dates for products specified under each allowance.

1.03 ADMINISTRATION
   A. Contractor's duties in selection of products under allowances
      1. Assist the Designer and Owner in determining qualified suppliers or installers.
      2. Obtain bids from suppliers and installers when requested by the Designer.
      3. Make appropriate recommendations for consideration of the Designer.
      4. Notify the Designer promptly of:
         a. Reasonable objections against a supplier, or party under consideration for installation.
         b. Effect on the Construction Schedule anticipated by selections under consideration.
   B. Adjustment of costs
      1. Continuously monitor the use of each allowance and the anticipated use to complete the Work. Do not exceed an allowance.
      2. If an allowance is at risk of being exceeded, request a modification to increase the allowance in a timely manner to avoid delay in the Work.
      3. If all of the Work of an allowance is complete and there is unexpended allowance remaining, request a modification to decrease the allowance to equal the amount that has been used.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
PART 1 - GENERAL

1.01 LIST OF ALLOWANCES

The following list of allowances is in addition to any quantity allowances specified as Unit Price Items.

Allowance No. A1: Quantity Allowance: Include 200 square feet of light-gauge steel ceiling framing and 5/8” gypsum board where existing plaster ceiling has been damaged or removed in room

Allowance No. A2: Quantity Allowance: Include the abatement and removal of 50 linear feet of pipe insulation containing asbestos

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Unit prices are subject to determination at the time of a Modification if the solicited unit price was not accepted and not listed in the Agreement.

B. Unit prices may be established by appropriate Modification.

C. Unit price items are listed in Section 01 22 15 with related sections for each.

D. If no base quantity is stipulated, or if the base quantity is zero, then the unit price is invalid.

E. Unit prices include all direct and indirect costs, except overhead and profit, associated with the unit price item, and are treated as direct prices to the Owner by the Contractor, regardless of whether the work of the unit price item is being performed by a subcontractor or a sub-subcontractor.

F. Each unit price multiplied by its base quantity constitutes an allowance included in the Contract Sum.

1.02 ADMINISTRATION

A. Use the related item number on all unit price documentation.

B. Represent the allowance for each unit price item as a distinct line item in the Schedule of Values.

C. Keep a daily log of actual quantities of specified work units encountered, consumed, or expended. When submitting an application for payment which includes payment for unit price items, provide Designer a copy or report of the log which is acceptable to Designer. Actual quantities and the Contractor’s log are subject to verification by Designer.

D. Adjustment of costs

1. Continuously monitor the consumption of each base quantity and the associated use of the allowance and the anticipated use to complete the Work. Do not exceed an allowance.

2. If a base quantity and the associated allowance are at risk of being exceeded, request a Modification to increase them in a timely manner to avoid delay in the Work.

3. If all of the Work of an allowance is complete and there is unexpended Allowance remaining, request a modification to decrease the allowance to equal the amount that has been used.

E. If adjustments exceed, or are expected to exceed, a cumulative twenty five percent (25%) of the initial base quantity, either party to the Contract may initiate renegotiation for a new unit price. Such a new unit price shall be made a part of the Contract by appropriate Modification.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
# 01 22 15 – LIST OF UNIT PRICES

## PART 1 - GENERAL

### 1.01 LIST OF UNIT PRICES

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Related Sections</th>
<th>Base Quantity</th>
<th>Unit</th>
<th>Unit Price Per Unit</th>
<th>Work Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>01 73 00</td>
<td>200</td>
<td>SF</td>
<td></td>
<td>Patch and repair of existing plaster ceiling.</td>
</tr>
<tr>
<td>A2</td>
<td>02 82 13</td>
<td>50</td>
<td>LF</td>
<td></td>
<td>Abatement of Pipe Insulation.</td>
</tr>
</tbody>
</table>

## PART 2 – PRODUCTS (Not Used)

## PART 3 – EXECUTION (Not Used)

END OF SECTION
SECTION 01 23 00 – 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 the 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. Alternate 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 alternates 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. Execute accepted alternates under the same conditions as other work of the Contract.

C. 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 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. A-1 “Floor drains in Toilet Rooms.”
   1. Base Bid: No floor drains in toilet rooms.
   2. Alternate: Install floor drains and related piping in toilet rooms as specified in Section 221319.13 Sanitary Drains and shown on sheets P-402 and P-405.

END OF SECTION 01 23 00
PART 1 - GENERAL

1.01 SUBSTITUTIONS:

A. Contractor assumes all risks associated with premature ordering and installation of substitute products.

B. The specifically named manufacturers, products, and systems, and descriptive characteristics used in the Contract Documents normally serve only to establish a level of quality and a performance standard. Unless a specific restriction is placed upon an item in the specifications, Contractor may submit proposals for substitutions. The Owner reserves the right to disallow substitutions.

C. Delays caused by tardiness of Contractor in preparing and forwarding submittals do not constitute an acceptable basis for consideration of substitute products. Delays due to factors which were in effect prior to project bidding do not constitute an acceptable basis for consideration of substitute products.

D. Decisions heretofore made concerning the equivalence or equality of materials, supplies and equipment furnished for or incorporated in other projects, completed or under construction for the Owner shall not be considered as precedents or criteria and shall have no bearing or influence on the question of equivalent, equal or comparable materials, supplies and equipment for the Work.

1.02 SUBSTITUTION REQUEST FORM:

A. Requests for substitutions shall be submitted to Designer on the form exhibited as Section 01 25 33, or in a similar format which provides the same or more information.

B. When making requests for substitutions, Contractor assumes the following responsibilities:
   1. To have investigated the proposed substitute product and determined it is equal or superior in all respects to that specified;
   2. To provide the same warranty for substitute that Contractor would for that specified;
   3. To provide complete cost data, and waive all claims for additional costs related to substitution which subsequently become apparent; and
   4. To coordinate installation of the accepted substitute, making such changes as may be required for Work to be complete in all respects.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
To: CLARK NEXSEN

Project: VA Campus Building 2 First Floor Renovation

Attention: Aaron Brumo, AIA Clark Nexsen
SBC Number: 369/005-06-2020

Specified Item Name and Manufacturer:
<<Item name and manufacturer>>

Proposed Substitute Item Name and Manufacturer:
<<Item name and manufacturer>>

1. The following are attached (mark all that apply):
   - [ ] Complete Description
   - [ ] Catalog
   - [ ] Laboratory Tests
   - [ ] Specifications Data

2. This substitution will have the following effects on dimensions, gauges, weights, etc.:
   <<Comments>>

3. This substitution will have the following effects on wiring, piping, ductwork, etc.:
   <<Comments>>

4. This substitution will have the following effects on other trades:
   <<Comments>>

5. This substitution will have the following effect on construction schedules:
   <<Comments>>

6. The proposed substitute(s) differs from the specified product(s) in quality and performance as follows:
   <<Comments>>

7. Manufacturer guarantees for the substitute(s) and the specified product(s) are (check one):
   - [ ] The Same
   - [ ] Different (if different, explain below)
   <<Comments>>
8. Information on the availability of maintenance services and replacement materials for proposed substitute(s) is provided on an attached sheet.
   □ Attached   □ Not Applicable

9. Names, addresses, and phone numbers of fabricators and suppliers for proposed substitute(s) are provided on an attached sheet.
   □ Attached   □ Not Applicable

10. If the proposed substitution is accepted, it will result in:
   □ No Cost Impact
   □ A Cost Decrease of $<<Amount>>
   □ A Cost Increase of $<<Amount>> As Shown on Attached Itemization

11. License fees or royalties are pending on the proposed substitute.
   □ No               □ Yes (if yes, explain below)
   <<Comments>>

12. The undersigned shall pay for additional studies, investigations, submittals, redesign, and analysis by the Designer necessitated by this substitution request.

   Substitutions must be requested in accordance with applicable Contract requirements. After bidding, substitutions are to be submitted only by Contractor. Substitute products should not be ordered or installed without written acceptance.

   Submitted By:

   Signature:  Date:  <<Date>>
   Printed Name:  <<Name>>  Firm Name:  <<Name>>

13. Designer Review and Comments:
   □ Accepted  □ Rejected
   □ Accepted as Noted  □ Rejected (received too late)
   □ Rejected (submitted incomplete)
   <<Comments>>

   Signature:  Date:
   Printed Name:  Firm Name:

14. Owner Review:
   Signature:  Date:

END OF SECTION
PART 1 - GENERAL

1.01 SUPPORTING DOCUMENTATION FOR PROPOSALS OR CLAIMS


B. For a change in the Work, specifically describe proposed change, or briefly describe the proposed change with specific reference to a completely descriptive attachment, such as a request for proposal from the Designer.

C. For a change in Contract Sum, state briefly the reason for change, state the amount, and provide itemization of values on the following forms or similar forms providing the same information:
   1. Section 01 26 54 Form for Price Summary, listing the itemizations of Work by subcontractors and the Contractor that together apply to an entire related change in work.
   2. Section 01 26 55 Form for Price of Work, detailing the quantities, units, costs, and extensions for materials, equipment, and labor, subtotaled, plus overhead, and profit related to a specific proposed change in the Work.
   3. Section 01 26 56 Form for Price of Time, if applicable, deriving an average cost per day.

D. For a change in Contract Time:
   1. Fully describe the extent of and reasons for the change and effect of the change on the construction schedule, and attach a revised construction schedule. Take into account weekends, holidays, and the specified standard baseline for weather delays during the period of the requested extension.
   2. For a change based on weather-related delay refer to Section 01 26 20.

1.02 SIGNATURES FOR CHANGE ORDER

Form shall be similar in format and content to Section 01 26 40 and signed by authorized representatives of the Owner, Designer, and Contractor according to the following procedure:

1. Designer prepares and submits supporting documents to Owner.
2. Owner produces and signs three (3) counterparts of form. Owner scans and transmits an informational copy to its construction representative, Designer, and Contractor.
3. Owner's construction representative brings owner's three original, signed counterparts to next progress meeting, unless urgency and opportunity make for a more timely execution.
4. Designer and Contractor both sign all three (3) counterparts at progress meeting. Each retains a counterpart, and the Owner's construction representative retains the third for the Owner.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
PART 1 - GENERAL

1.01 EXTENSION OF CONTRACT TIME

If a Claim is made for an extension of time based upon weather delays in accordance with the General Conditions an extension may be granted only for the number of weather delay days in excess of the number of days listed for the applicable month on the standard baseline.

1.02 STANDARD BASELINE FOR ADVERSE WEATHER

A. The standard baseline is defined as the number of calendar days for each month during which construction activity exposed to weather conditions is expected to be prevented and suspended by cause of adverse weather. Suspension of construction activity for the number of days each month as listed in the standard baseline is included in the Work and is not eligible for extension of Contract Time.

B. The Owner has established a standard baseline for the State of Tennessee as follows:

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>12</td>
</tr>
<tr>
<td>Feb</td>
<td>11</td>
</tr>
<tr>
<td>Mar</td>
<td>8</td>
</tr>
<tr>
<td>Apr</td>
<td>7</td>
</tr>
<tr>
<td>May</td>
<td>7</td>
</tr>
<tr>
<td>Jun</td>
<td>6</td>
</tr>
<tr>
<td>Jul</td>
<td>7</td>
</tr>
<tr>
<td>Aug</td>
<td>5</td>
</tr>
<tr>
<td>Sep</td>
<td>4</td>
</tr>
<tr>
<td>Oct</td>
<td>5</td>
</tr>
<tr>
<td>Nov</td>
<td>6</td>
</tr>
<tr>
<td>Dec</td>
<td>11</td>
</tr>
</tbody>
</table>

1.03 ADVERSE WEATHER AND WEATHER DELAY DAYS

A. Adverse weather is defined as the occurrence of one or more of the following conditions within a 24 hour day that prevents construction activity exposed to weather conditions or access to the site:

1. Precipitation (rain, snow, or ice) in excess of one-tenth inch liquid measure.
2. Temperatures that do not rise above the minimum required for the day’s construction activity, if such temperature requirement is specified or accepted as standard industry practice.
3. Sustained wind speed in excess of the maximum for the day’s construction activity, if such sustained wind speed maximum is specified or accepted as standard industry practice.
4. Dry out days under the following conditions:
   a. more precipitation days occur than listed in the standard baseline;
   b. there is a hindrance to site access or sitework and Contractor has taken all reasonable accommodations to avoid such hindrance; and,
   c. no more than one dry out day is allocated for each additional day of precipitation more than the standard baseline that total one inch or more, liquid measure, unless specifically recommended by the Designer.

B. A weather delay day may be counted if adverse weather prevents work on the project for 50% or more of the contractor’s scheduled work day and critical path construction activities were included in the day’s schedule, including a weekend day or holiday if Contractor has scheduled construction activities that day.
1.04 DOCUMENTATION AND SUBMITTALS

A. Weather Delay Report:

1. Use a copy of Section 01 26 25 as a weather delay report, indicating for each calendar month the days on which construction activity affecting the critical path of the Work was prevented by weather conditions.

2. In the column for the cause, indicate measurement of precipitation, temperature, wind, or other influencing factors.

3. Describe the construction activity that was scheduled, on the critical path, and delayed.

4. At the end of the month, add up the number of days delay, subtract the baseline number given in this Section, and show the resulting claimable days in excess of baseline.

5. Submit a copy of the completed report with the next application for payment. Reports submitted with applications for payment do not constitute a claim or preliminary claim for extension of time.

B. Claim for a time extension based on weather delay(s):

1. Submit a copy of all reports completed since the last month for which a time extension was previously claimed, or the commencement of Work if no previous claim, through the last month for which delay is being claimed. Claims for time extension based upon weather delays are unjustified if a submitted report does not corroborate the claim or if no report was submitted when it was required with an application for payment.

2. Submit daily jobsite work logs showing which and to what extent critical path construction activities have been affected by weather on a monthly basis.

3. Submit actual weather data to support claim for time extension obtained from nearest NOAA weather station or other independently verified source approved by Designer at beginning of project.

4. Organize claim documentation to facilitate evaluation on a basis of calendar month periods and the standard baseline.

5. Submit in accordance with the requirements of the Contract Documents.
<table>
<thead>
<tr>
<th>Date</th>
<th>Weather condition causing delay</th>
<th>Work scheduled on critical path for this day that was delayed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of days this month with delay due to weather
Baseline number from Section 01 26 20
Total – Baseline = claimable days

END OF SECTION
Amendment

PROJECT: VA Campus Building 2 First Floor Renovation

Project Number: SBC #369/005-06-2020

Original Contract Date: Date This Change Initiated:

The following changes in the Contract are hereby directed:

<table>
<thead>
<tr>
<th>Item</th>
<th>Reference</th>
<th>Work</th>
<th>Contract Sum</th>
<th>Contract Time</th>
</tr>
</thead>
</table>

The original Contract Sum ............................................................................................. $

Net Change previously authorized .................................................................................... $

The Contract Sum prior to this Modification .................................................................... $

This modification (in increases / does not change / decreases) the Contract Sum... $

The new Contract Sum, including this modification ........................................................ $

This Modification (in increases / does not change / decreases) the Contract Time...

The new Contract Time, including this Modification .......................................................

The last day of the Contract Time, including this Modification........................................

CONTRACTOR
Signed
Name & Date
For

DESIGNER
Signed
Name & Date
For

OWNER
Signed
Name & Date
For

Changes over 10% cumulatively or exceeding $500,000.00, STATE ARCHITECT:

Signed
Name
Date
### FORM FOR PRICE SUMMARY

SBC Project Number: 

Project Name: 

Name of General Contractor: 

Proposal Number: 

Date Itemized: 

Page of pages 

<table>
<thead>
<tr>
<th>Work by Subcontractors</th>
<th>Name of Subcontractor</th>
<th>Costs and Allowances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subtotal: 0.00

General Contractor mark-up on Subtotal: \[\text{\%} \] = 0.00

Subtotal for General Contractor for work by subcontractors: 0.00

<table>
<thead>
<tr>
<th>Work by General Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Subtotal (including Subcontractors and the General Contractor): 0.00

Bond Premium: \[\text{\%} \] = 0.00

Total: 0.00

---

Cells with red underline (if viewed in color) are for you to fill in. Others are protected. Rounding off is permitted if rounding up for decreases and rounding down for increases. Math functions in Excel show rounded to nearest penny, but carry exact value for calculations. Let embedded math do its work.

This spreadsheet is available on the Owner's Designers' Manual website.
**Project Name:** VA Campus Building 2 First Floor Renovation

<table>
<thead>
<tr>
<th>Description</th>
<th>Material Quantity</th>
<th>Material Unit</th>
<th>Material Cost</th>
<th>Material Extension</th>
<th>Equipment Quantity</th>
<th>Equipment Unit</th>
<th>Equipment Cost</th>
<th>Equipment Extension</th>
<th>Labor Quantity</th>
<th>Labor Unit</th>
<th>Labor Cost</th>
<th>Labor Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Materials Subtotal:** 0.00

**Equipment Subtotal:** 0.00

**Labor Subtotal:** 0.00

**% Sales Tax:** 0.00

**% Burden:** 0.00

**Cost:** 0.00

**Cost:** 0.00

**Cost:** 0.00

Subtotal of Costs of Materials + Equipment + Labor = $ 0.00

10% Overhead allowed on costs = $ 0.00

Subtotal of Costs + Overhead = $ 0.00

5% Profit allowed on Costs + Overhead = $ 0.00

Total for this change = $ 0.00
THIS PAGE INTENTIONALLY LEFT BLANK
<table>
<thead>
<tr>
<th>Description</th>
<th>Period Cost</th>
<th>Period (Year, Month, Week, Day)</th>
<th>Cost Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superintendent Salary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superintendent Vehicle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Use Vehicles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Office</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Office Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fax Machine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copier</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typewriter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Office Utilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telephone Service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Site Storage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trailer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Program</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Toilet(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subtotal of Costs:  
5% for Profit:  
Total per day:
PART 1 - GENERAL

1.01 BASIC REQUIREMENTS

A. Reference Tennessee Code Annotated (TCA) § 66-34-104.

B. In accordance with State law retainage shall be deposited into an interest-bearing escrow account if the original Contract Sum is $500,000 or greater.

C. Failure to have the escrow account operational by the time of the Contractor's second application for payment will result in delay of payment or inability of the Owner to make payment. Any such delay or inability to pay will not be grounds for relief under the prompt payment statutes.

1.01 BANKING INSTITUTION REQUIREMENTS

The banking institution handling the retainage escrow account must be in an appropriate custodial care agreement with the State Treasurer. If not already in such an agreement, a banking institution can request such an agreement from the State Treasurer, subject to meeting eligibility requirements of TCA §12-4-108(c).

1.03 PROCESS

A. Shortly after award of contract, the Tennessee Department of Finance and Administration (F&A) will send the Contractor information for starting the account. This information typically includes the following:

1. Procedural guide

2. Forms including the basic application provided herein as Form A.

3. List of banks that currently have agreements with the State to host retainage escrow accounts.

B. The instructions from F&A will include a name and phone number to call for help if the Contractor needs help completing Form A or if the Contractor plans to use a lending institution that does not have a current agreement with the State for hosting retainage escrow.

C. Immediately upon award of a contract with a Contract Sum of $500,000 or greater, complete the Form A shown in this section, arrange for the completed Form A to be executed by the escrow bank, and instruct the bank to submit the original wet-signature Form A to the following address.

Retainage Escrow Coordinator
Tennessee Department of Finance and Administration
Office of Business and Finance
Suite 2000 William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue
Nashville TN 37243-0294
FORM A
APPLICATION FOR THE SUBSTITUTION OF SECURITIES FOR ALL AMOUNTS RETAINED ON STATE BUILDING COMMISSION CONSTRUCTION CONTRACTS

Date: ________________________________

RE: Contract Number: ____________________
Project No.: ____________________
Location: ____________________

Dear State Building Commission:

Pursuant to the provisions of Tennessee Code Annotated, Sections 12-4-108, ____________ hereby requests that whenever payment for which certain amounts are retained by the State Building Commission as determined by the subject construction contract, the amount so retained be substituted for approved securities, as designated by the Tennessee State Treasurer.

The undersigned Contractor hereby appoints ____________________ (Name of Banking Institution) located at ____________________ (Complete Address of Banking Institution) to be its agent and attorney-in-fact to receive all amounts retained by the State Building Commission under the provisions of the subject construction Contract and to purchase Retainage Securities of the following type: ____________________ (Description & Account Number)

The appointed Banking Institution, as indicated by the acceptance signature shown below, agrees to enter or has already entered into a Trust Agreement with the Tennessee State Treasurer to act as custodian and servicing agent of Retainage Securities and to perform all assigned duties and responsibilities with respect thereto as set forth in the Trust Agreement, which is herein incorporated by reference.

Very truly yours,

(Signature of Authorized Representative of Contractor) (Title)

ACCEPTED:

(Signature of Authorized Officer of Banking Institution) (Title)

CONTACT PERSON (BANK) ____________________ PLEASE PRINT

PHONE NUMBER ____________________

END OF SECTION
PART 1 - GENERAL

1.01 FORM AND APPROVAL
   A. The form for the Schedule of Values shall be AIA Document G703 Continuation Sheet.
   B. If objected to by the Designer or the Owner revise and resubmit the Schedule of Values to the Designer's and Owner's satisfaction prior to submitting an Application for Payment.

1.02 LEVEL OF DETAIL
   A. Provide a breakdown of the Contract Sum in sufficient detail to facilitate ongoing evaluation of Applications for Payment and progress measurement and reports.
   B. Round off line items to the nearest whole dollar with the total equal to the Contract Sum.

1.03 ALLOCATION OF VALUES
   A. Phases:
      1. If Phases are stipulated with distinct commencement, duration, or completion requirements, divide the allocation to correspond to the Phases.
      2. Within each Phase subdivide the allocations as described below and subtotal.
   B. Sitework:
      Provide line items for sitework including categories for site utilities, roads and parking, and appurtenances according to general type and physical separation.
   C. Each involved building or major structure:
      1. Categorize items by major trades or units of work corresponding to the divisions and sections of the specifications.
      2. Further subdivide as desired but maintain a distinct and identifiable correspondence to this allocation.
   D. If allowances are stipulated in the Work, provide a line item in the Schedule of Values for each allowance, including quantity allowances associated with Unit Prices. If the project has phases associate the allowance with the relevant phase.
   E. If the Contract is a CM/GC contract based on a Guaranteed Maximum Price (GMP) with estimated trades identified as a part of the GMP, provide a distinct line item for each estimated trade.
   F. Prior to receipt of written approval of a Change Order, do not show in any respect a Change Order intended to modify the Contract sum, regardless of the Change Order's status prior to being fully execute. After a Change Order which modifies the Contract Sum is approved and fully executed by the Owner show the Change Order as follows.
      1. Provide a single line item for each fully executed Change Order with identification by Change Order number.
      2. Maintain these line items through the balance of the project.
   G. For the final statement of accounting incorporate Change Orders that modify the Contract Sum into the appropriate allocations.

END OF SECTION
PART 1 – GENERAL

1.01 SUBMITTAL:

A. In each Application for Payment provide the document indicated in the following table according to its context.

<table>
<thead>
<tr>
<th>Counterpart or Copy</th>
<th>Progress Payment</th>
<th>Reducing Upon Subst. Completion</th>
<th>Final Payment</th>
<th>Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>counterpart</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>G702 Application</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>G703 Continuation</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Final Accounting</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>Contingency &amp; Reserve Logs (if CM/GC)</td>
</tr>
<tr>
<td>copy</td>
<td>if any</td>
<td>if any</td>
<td>no</td>
<td>Off-Site Stored Materials documents</td>
</tr>
<tr>
<td>counterpart</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Affidavit of Payment</td>
</tr>
<tr>
<td>counterpart</td>
<td>no</td>
<td>YES</td>
<td>YES</td>
<td>Consent of Surety with Power of Attorney</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Insurance Certificate</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Statement of Continuing Insurability</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>if any</td>
<td>if any</td>
<td>U&amp;O Permit</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>YES</td>
<td>YES</td>
<td>Data Binder Receipt(s)</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Roof Warranty or Warranties</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Report of Subcontractors and Suppliers</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>if any</td>
<td>no</td>
<td>Visitor Log</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>if any</td>
<td>no</td>
<td>Weather Delay Report</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>If any</td>
<td>YES</td>
<td>Submittals Log per 01 31 90</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>If any</td>
<td>YES</td>
<td>Construction Schedule per 01 32 00</td>
</tr>
</tbody>
</table>

B. Provide application documents assembled in order listed above on 8½” x 11” pages, except 11” x 17” pages can be used for Progress Schedules and Submittal Logs if folded to fit an 8½” x 11” size. Orient all pages as shown below. Provide application sets bound with a single clip (no staple) affixed to the upper left of the G702 first page (according to its orientation).

C. Counterpart documents shall be original instruments with wet signatures and embossed or wet-stamped seals, in each set of application documents.
D. Provide a draft submission, including attachments, as a PDF attached to an email, to Designer and to the Owner’s construction representative three days prior to actual submittal.

E. Provide actual submission of five sets of the application documents to the Designer at progress meeting, substantial completion inspection meeting, or final inspection meeting. If submitted outside of these meetings, provide conveyance of application to Designer, from Designer to Owner’s construction representative, and from Owner’s construction representative to Owner’s central office.

1.02 INCLUSIONS AND CALCULATIONS:

A. Accurately represent all values with two decimal places, calculated to the penny.

B. Stored Materials: Materials suitably stored on-site but not yet incorporated into the Work can be included; and, those suitably stored off-site can be included if documented in accordance with later provisions of this section.

C. On CM/GC contracts, the total completed and stored to date for estimated trades can only be included once bids have been taken, subcontracts awarded, and the actual price reconciled to the Reserve Log.

D. Calculation of retainage and amounts withheld:

1. Credit for completed work and stored materials, and deductions for incomplete work, comprise the Total Completed and Stored to Date. The Total Completed and Stored to Date shall not include the value of punch list items that remain incomplete after Substantial Completion.

2. Retainage is calculated as a percentage of Total Completed and Stored to Date: 5% prior to Substantial Completion; 2% after Substantial Completion; then, none at final payment. In the continuation sheets, showing retainage at individual line items is not required and is discouraged, as it promotes rounding errors. Retainage should only be shown at phase sub-totals, if phases exist, and when retainage rates vary between phases.

3. Other amounts withheld (i.e., potential liquidated damages or in response to subcontractor claims of non-payment) can be added to the continuation sheet and deducted from the Total Completed and Stored to Date, or can be deducted from the resulting current payment due after retainage and prior payments are accounted.

E. If a billing period would cross a State fiscal year (ending June 30, starting July 1), provide separate pay requests for the portion of work performed in each fiscal year.

1.03 FORMS, FORMAT, AND CONTENT:

A. G702 Application: Use AIA Document G702 Application and Certificate for Payment

1. For project identification, include the Owner’s project number featured prominently, institution name, and work name, which is normally the project title shown in the Agreement.

2. Provide a unique, sequential application number.

3. Include the Contractor’s address exactly as provided in the ACH Form.

4. Show the county where the Work is located, normally where AIA captions “Contract for”.
B. G703 Continuation: Use AIA Document G703 Continuation Sheet itemized with the line items and values of the schedule of values accepted by Designer, and values and percentages for each line item. If there are phases, include a sub-total for each phase as well as a grand total.

C. Final Accounting: Allocate final Contract Sum as if Modifications had been fully incorporated in Contract Sum at award of Contract, and shall follow the same format as the schedule of values.

D. GMP Contingency Log and Reserve Log, only if a CM/GC contract.

E. Off-Site Stored Materials: If any, provide the following.
   1. Statement identifying where materials are stored, and assuring that materials are tagged to identify them for use in the project.
   2. Bill(s) of sale for materials claimed that list(s) all items.
   3. Certificate of insurance covering materials claimed, recognizing Owner's right to make claims.

F. Affidavit of Payment of Debts and Claims: Provide counterpart using AIA Document G706, when requesting final payment for the Work or reduction of retainage to zero for any portion of the Work.

G. Consent of Surety:
   1. If seeking reduction in retainage prior to final payment for the entire Work, or final payment on only a portion of the Work, provide counterpart using AIA Document G707A Consent of Surety to Reduction in Retainage, or a similarly formed letter.
   2. If seeking final payment, provide counterpart using AIA Document G707 Consent of Surety Company to Final Payment, or a similarly formed letter.
   3. If Contractor has listed exceptions in the affidavit of payment, Surety’s consent shall acknowledge such exceptions.
   4. If Contract is not bonded, consent of surety is not required, and Owner will instead advertise a public notice of settlement, and wait 30 days for responses, before accepting the application.
   5. Provide counterpart of power of attorney with consent of surety.

H. Insurance Certificate: If seeking final payment, provide certificate of insurance for products and completed operations as required by the General Conditions of the Contract for Construction.

I. Statement of continuing insurability: If seeking final payment, a letter written to the effect required by the General Conditions of the Contract.

J. Use & Occupancy Permit (some jurisdictions have a different name): Provide copy with first application following substantial completion.

K. Data Binder Receipt:
   1. With first application following substantial completion, provide copy of document identifying to whom Contractor delivered the operating and maintenance data binders.
   2. With application for final payment, provide copy of document identifying to whom Contractor delivered project data binders.
01 29 76 – PROGRESS PAYMENT PROCEDURES

L. Roof Warranty or Warranties, if any required, on the Owner’s section 07 50 36 standard form.

M. Report of Subcontractors and Suppliers, on the standard form.

N. Visitor Log for the period covered by application. After substantial completion, provide log(s) for periods prior to substantial completion that have not been provided in a prior application.

O. Weather Delay Report for all calendar months completed, up to the date of substantial completion, and not previously submitted.

1.04 CERTIFICATION

A. Designer, if in disagreement with the amounts claimed in an application, may either return application to Contractor for revision and resubmittal, or revise application by hand to indicate corrections Designer considers appropriate.

B. Designer, finding an application complete and correct, will certify the application and return one of the sets to Contractor to indicate the action taken.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
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. RFIs
4. Digital project management procedures
5. Project meetings

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 012600, “Construction Modification Procedures” for procedures for submitting and handling change orders.
2. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
5. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from 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, telephone number, and email address 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.

B. Key Personnel Names: Within 15 days of starting construction operations, 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 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.

1.5 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 own 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. Pre-installation 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.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other sections for dispositions of salvaged materials that are designated as Owner’s property.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
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 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 by Architect 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 weekly. Use software log that is part of web-based Project software. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
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 appropriated.
2. Identification of related Field Order, Work Change Directive and Proposal Request, as appropriate.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model and consultants’ CAD drawings will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
4. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement. Contractor shall hold the licensing agreement for all subcontractors.

B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare 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. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
B. Preconstruction Conference: 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. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, 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.

2. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Responsibilities and personnel assignments.
   b. Tentative construction schedule.
   c. Phasing.
   d. Critical work sequencing and long lead items.
   e. Designation of key personnel and their duties.
   f. Lines of communications.
   g. Use of web-based Project software.
   h. Procedures for processing field decisions and Change Orders.
   i. Procedures for RFIs.
   j. Procedures for testing and inspecting.
   k. Procedures for processing Applications for Payment.
   l. Distribution of the Contract Documents.
   m. Submittal procedures.
   n. Sustainable design requirements.
   o. Preparation of Record Documents.
   p. Use of the premises and existing structures on site to remain.
   q. Work restrictions.
   r. Working hours.
   s. Owner's occupancy requirements.
   t. Responsibility for temporary facilities and controls.
   u. Procedures for moisture and mold control.
   v. Procedures for disruptions and shutdowns.
   w. Construction waste management and recycling.
   x. Parking availability.
   y. Office, work, and storage areas.
   z. Equipment deliveries and priorities.
   aa. First aid.
   cc. Progress cleaning.

3. Minutes: Contractor will be responsible for conducting meeting, recording and distribution of meeting minutes.

C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity when required by other sections and when required for 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, and Owner's Commissioning Authority of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

   b. Options.
   c. Related RFI's.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Sustainable design requirements.
   i. Review of mockups.
   j. Possible conflicts.
   k. Compatibility requirements.
   l. Time schedules.
   m. Weather limitations.
   n. Manufacturer's written instructions.
   o. Warranty requirements.
   q. Acceptability of substrates.
   r. Temporary facilities and controls.
   s. Space and access limitations.
   t. Regulations of authorities having jurisdiction.
   u. Testing and inspecting requirements.
   v. Installation procedures.
   w. Coordination with other work.
   x. Required performance results.
   y. Protection of adjacent work.
   z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. 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.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.

   1. Conduct the conference to review requirements and responsibilities related to Project closeout.
   2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the
meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

   a. Preparation of Record Documents.
   b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
   c. Procedures for completing and archiving web-based Project software site data files.
   d. Submittal of written warranties.
   e. Requirements for completing sustainable design documentation.
   f. Requirements for preparing operations and maintenance data.
   g. Requirements for delivery of material samples, attic stock, and spare parts.
   h. Requirements for demonstration and training.
   i. Preparation of Contractor's punch list.
   j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
   k. Submittal procedures.
   l. Coordination of separate contracts.
   m. Owner's partial occupancy requirements.
   n. Installation of Owner's furniture, fixtures, and equipment.
   o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at weekly intervals.

   1. Coordinate dates of meetings with preparation of payment requests.
   2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Contractor, 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.

      a. 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.

      b. Review present and future needs of each entity present, including the following:
1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Status of sustainable design documentation.
6) Deliveries.
7) Off-site fabrication.
8) Access.
9) Site use.
10) Temporary facilities and controls.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of Proposal Requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

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.

F. 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 pre-installation conferences.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Contractor, 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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined 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.
b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Status of RFIs.
15) Proposal Requests.
16) Change Orders.
17) Pending changes.

3. 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
PART 1 - GENERAL

1.01 SUBMITTALS LOG

A. If any shop drawings, product data, or sample submittals are required by the Contract Documents, maintain a submittals log to record the status of submittals made to the Designer.

B. Process:
   1. Submit three (3) copies with each Application for Payment.
   2. Clearly identify the Project.
   3. Record activities with respect to shop drawings, product data, samples, and such other submittals which are required by the Contract Documents.
   4. Indicate for each submittal made to date:
      a. Title or name, and type of submittal.
      b. Date submitted to the Designer.
      c. Date returned by the Designer.
      d. General nature of the Designer's response.

1.02 VISITOR LOG

A. Maintain visitor log in the field office (or with the project superintendent when no field office is required) to record visits by all persons not a part of the Contractor's forces, materials suppliers, or subcontractors' forces, until substantial completion of the entire Work.

B. Process:
   1. Submit a copy with each counterpart of each application for payment, covering the period since the last log(s) submitted.
   2. Clearly identify the Project.
   3. Use the form of specification Section 01 31 93, and indicate:
      a. Visitor name and affiliation.
      b. Date and time of visit.
      c. Length of time on site.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
Please print information below if you represent the Owner, institution, Designer or a consultant, a testing agency engaged by the Owner or Designer, a regulatory authority, or yourself as a private individual. Please estimate how long you will be on site, rather than logging out when you leave.

Persons who are employed by the Contractor, a subcontractor, a sub-subcontractor, a supplier, or a testing agency engaged by any of these, are NOT VISITORS, and should not log in on this Log.

<table>
<thead>
<tr>
<th>Name</th>
<th>Representing</th>
<th>Arrival Date and Time</th>
<th>How Long On Site</th>
<th>Phone No. While On Site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
THIS PAGE INTENTIONALLY LEFT BLANK
PART 1 – GENERAL

1.01 IDENTIFICATION
   A. Identify clearly the Project, SBC Number, and date of issuance or revision on each submitted schedule.

1.02 CONSTRUCTION SCHEDULE FORMAT
   A. Use a bar chart or critical path schedule format or other method approved by the Designer. A critical path schedule is recommended to enable meeting requirements for documentation for time extension requests.
   B. Utilize a construction scheduling software for development and updates.
   C. Outline the orderly progress of the Work as planned from the Notice to Proceed through Substantial Completion on the contractually required date.
   D. Categorize the Work by major work area and distinct trade or team. If phases are specified also categorize by phase.
   E. Divide work activities into one month or less duration.
   F. Provide an identifiable relationship to the schedule of values.
   G. Identify projected monthly progress, points of 50% completion and Substantial Completion, and other major milestones.
   H. If included in the Work, commissioning and storm water pollution protection plan activities shall be major milestones.
   I. If planting that is seasonally sensitive is included in the Work, show such distinctly in a seasonally appropriate time.
   J. Transmit the schedule in PDF format when requested by the Owner or Designer.

1.03 INITIAL CONSTRUCTION SCHEDULE
   Submit within 21 days of award of the Contract and no later than the date of submission of the first Application for Payment.

1.04 UPDATED CONSTRUCTION SCHEDULE
   A. Submit a copy attached to each counterpart of Applications for Payment.
   B. Format in a manner similar to the initial progress schedule and as follows:
      1. Indicate the initial construction schedule for the Work.
      2. Identify the actual progress through the period covered by the current Application for Payment.
      3. Indicate the planned progress through Substantial Completion including extensions of time made by Modification.
      4. If actual progress falls behind previous projections, indicate the recovery plan so that the Work will be completed on time.

1.05 SUBMITTALS SCHEDULE
   A. Submit in writing with the initial construction schedule.
   B. The submittals schedule may be incorporated into the construction schedule if clearly identified.
C. Identify submittals to be made.
D. Show date for submission and date by which Designer should respond, allowing sufficient time for review. Designer may require revision of the submittals schedule if times allotted for review are insufficient.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
SECTION 01 32 33 - PHOTOGRAPHIC 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 the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.

B. Related Requirements:

1. Section 01 77 70 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 01 79 21 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 02 41 16 "Structure Demolition" for photographic documentation before building demolition operations commence.
4. Section 02 41 19 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within five days of taking photographs.

1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based project software site:

   a. Name of Project.
   b. Date photograph was taken.
   c. Description of location, vantage point, and direction.
   d. Unique sequential identifier keyed to accompanying key plan.
1.4 QUALITY ASSURANCE

A. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.

1. Flag construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take 100 photographs after date of Substantial Completion for submission as Project Record Documents.
F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum or in the allowance for construction photographs.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:
   a. Special events planned at Project site.
   b. Immediate follow-up when on-site events result in construction damage or losses.
   c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
   d. Substantial Completion of a major phase or component of the Work.
   e. Extra record photographs at time of final acceptance.
   f. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 33
SECTION 01 33 00 - 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:
   1. Submittal schedule requirements.
   2. Administrative and procedural requirements for submittals.

B. Related Requirements:
   1. Section 01 29 76 "Progress Payment Procedures" for submitting Applications for Payment and the schedule of values.
   2. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
   3. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
   4. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
   5. Section 01 77 70 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
   6. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   7. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   8. Section 01 79 21 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
   9. Section 01 81 14 “High Performance Building Requirements (HPBr)” for sustainable design requirements.

1.3 DEFINITION

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."

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list 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.

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 dates for purchasing.
   h. Scheduled date of fabrication.
   i. Scheduled dates for installation.
   j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect. CC (Carbon Copy) the ETSU Project Manager at the same time submittals are sent to the Architect.


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 submittals for related parts of the Work specified in different Sections 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 21 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 15 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 21 days for initial review of each submittal.
   5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 21 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

D. 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.

E. 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.

F. 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.

1.7 SUBMITTAL REQUIREMENTS

A. 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 unsuitable 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 that show 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 Shop Drawings, and before or concurrent with Samples.

B. 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.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Contractor shall make submittals of products requiring color selection as a group. Final color selections cannot be released until the full package of samples has been submitted and reviewed by the Owner. It is imperative that sample submittals be made as early as possible in the construction period to avoid delays in release of products for purchase.

2. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

3. Identification: Permanently attach label on unexposed side of Samples that includes the following:
   a. Project name and submittal number.
   b. Generic description of Sample.
   c. Product name and name of manufacturer.
   d. Sample source.
   e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

4. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.

5. 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.

6. 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 one 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.

7. 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 two Sample sets: One for the Owner’s use and one for records. The remainder will be returned to the Contractor.

      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.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
E. 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.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit 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. Provide a notarized signature where indicated.
2. 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.
3. 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.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

H. Test and Research Reports:

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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:

a. Name of evaluation organization.
b. Date of evaluation.
c. Time period when report is in effect.
d. Product and manufacturers' names.
e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.8 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 insufficient 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 digitally signed PDF file copy 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.

1.9 CONTRACTOR'S REVIEW

A. Action Submittals 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. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp and indication in web-based Project software. Include 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.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.
1.10 ARCHITECT’S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:

   a. APPROVED: When submittals are marked APPROVED, that part of the work covered by the submittals may proceed provided it complies with requirements of the final documents; final acceptance will depend on that compliance.
   b. NO ACTION TAKEN: Submittal is not a required submittal, and will be kept as part of the project record.
   c. REJECTED: When submittals are marked REJECTED, do not proceed with the part of the Work covered by the submittal, including fabrication, delivery or any other activity. Revise or prepare a new submittal in accordance with notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
   d. APPROVED AS NOTED: When submittals are marked APPROVED AS NOTED, that part of the Work covered by the submittal may proceed provided it complies with the notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on compliance.
   e. REVISE AND RESUBMIT: When submittals are marked REVISE AND RESUBMIT, do not proceed with the part of the work covered by the submittal, including fabrication, delivery or other activity. Revise or prepare a new submittal in accordance with notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
   f. DELEGATED DESIGN SUBMITTAL: When submittals are marked DELEGATED DESIGN SUBMITTAL, the part of the work covered by the submittal will require certification of design professional as part of the manufacturer’s team. Follow requirements as indicated above.
   g. Do not permit submittals marked REJECTED or REVISE AND RESUBMIT to be used at the project site or elsewhere Work is in progress.
   h. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Design Professional will review each submittal, mark to indicate action taken and return promptly. Compliance with specified characteristics is the Contractor’s responsibility.

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. Architect will return without review submittals received from sources other than Contractor.
F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00
SECTION 01 40 00 - 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 inspection 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 quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

4. Specific test and inspection requirements are not specified in this Section.

C. Related Requirements:

1. Section 01 21 00 "Allowances" for testing and inspection allowances.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described 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.

B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
C. 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, assembly, 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).

D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and 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.

1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies. Extent of mock-up required is provided on the drawings.

2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.

E. 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.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. 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.

J. 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. Contractor's quality-control services do not include contract administration activities performed by Architect.
1.4 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.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements 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 direction 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.

1.6 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mock-up, provide plans, sections and elevations, indicating materials and size of mock-up construction.

1. Include plans, sections, and elevations, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 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 submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

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.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, 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.

1.8 CONSTRUCTION MANAGER’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. Distinguish source quality-control tests and inspections from field quality-control 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, including tests and inspections indicated to be performed by Commissioning Authority.
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.

1.9 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, telephone number, and email address 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.
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 inspection.
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 re-inspecting.

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, telephone number, and email address 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, telephone number, and email address 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.

1.10 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

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, applying, 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 inspection 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. 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 of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's and Owner’s approval of mockups before starting corresponding work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed unless otherwise indicated.

K. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

1.11 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 inspection they are engaged to perform.
2. Payment for these services will be made from testing and inspection allowances, as authorized by Change Orders.
3. Costs for retesting and re-inspecting 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, whether specified or not, to verify and document that the Work complies with requirements.

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. Engage a qualified testing agency to perform 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 inspection 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 inspection 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. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Construction Manager @ Risk in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Construction Manager @ Risk promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations 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 duties of Contractor.

E. 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."

F. 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 pre-installation 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.
G. Associated Contractor Services: Cooperate with agencies and representatives 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 inspection. 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 inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

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, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections as noted elsewhere in this specification and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Construction Manager @ Risk 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 and Commissioning Authority with copy to Construction Manager @ Risk 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 re-inspecting 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, Commissioning Authority's, reference during normal working hours.
   1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION
A. General: On completion of testing, inspection, 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 01 40 00
PART 1 - GENERAL

1.01 APPLICABLE CODES, RULES, STANDARDS, REGULATIONS, AND LAWS

A. Comply with all applicable codes, standards, regulations and laws.

B. The following is a list of major codes that may govern the project. It is not to be considered all-inclusive of codes and regulations that may apply and current revisions and editions must be confirmed.

1. Currently adopted codes of the Tennessee Department of Commerce and Insurance, State Fire Marshal’s Office. Refer to the Codes Enforcement section of the Office’s web site for further information which may include, but is not limited to the following.
   a. building codes
   b. fuel gas codes
   c. mechanical codes
   d. plumbing codes
   e. property maintenance codes
   f. fire codes
   g. energy conservation codes
   h. existing building codes
   i. fire protection and life safety codes

2. Current rules of the Tennessee Department of Commerce and Insurance, Division of Fire Prevention. Refer to the Division’s web site for further information which may include, but is not limited to the following.
   a. electrical installation rules
   b. equitable restroom rules
   c. construction plans and specifications review rules

3. Current rules of the Tennessee Department of Labor and Workforce Development, Board of Boiler Rules. Refer to the Board’s web site for further information.


5. The Tennessee Public Building Accessibility Act, Tennessee Code Annotated (TCA) § 68-120-204 with comments as follows. Reference the web site of the Tennessee Department of Commerce and Insurance, Division of Fire Protection.
   a. ADA Title II, State and local government facilities must follow the requirements of the 2010 standards, including both the Title II regulations at 28 CFR 35.151 and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. In the few places where requirements between the two differ, the requirements of 28 CFR 35.151 prevail. The compliance date is March 15,
2012, for all newly constructed or altered State and local government facilities permitted after this date.

b. ADA Title III, Public accommodations and commercial facilities must follow the requirements of the 2010 standards, including both the Title III regulations at 28 CFR part 36, subpart D: and the 2004 ADAAG at 36 CFR part1191, appendices B and D. In the few places where requirements between the two differ, the requirements of 28 CFR part 36, subpart D prevail. The compliance date is March 15, 2012, for all newly constructed or altered facilities permitted after this date.

c. Reference:
   U.S. Department of Justice
   Civil Rights Division,
   Disability Rights Section-NYA
   950 Pennsylvania Ave, NW
   Washington, DC 20530
   (202) 514-4609


7. ASHRAE Standards:
   a. 62.1-2013, Ventilation for Acceptable Indoor Air Quality
   b. 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings. A COMCHECK compliance certificate for envelope, interior lighting, exterior lighting, and mechanical must be submitted with the designers seal affixed to it.
PART 1 - GENERAL

1.01 TESTING REQUIRED BY SECTIONS 1704 AND 1705 OF THE INTERNATIONAL BUILDING CODE

For the types of work listed under Sections 1704 and 1705 of the International Building Code, the Owner and Designer shall make arrangements for the employment and payment of services of approved agencies to perform inspections and tests.

1.02 TESTING OTHER THAN THAT REQUIRED BY SECTIONS 1704 AND 1705 OF THE INTERNATIONAL BUILDING CODE

A. For the types of work not listed under Sections 1704 and 1705 of the International Building Code the Contractor shall employ and pay for the services of an independent testing laboratory, approved by the Designer, to perform specified services and testing. Employment of laboratory does not relieve Contractor's obligations to perform the Work.

B. Coordinate and pay for inspections and testing required by law, ordinance, rules, regulations, orders, or approvals of public authorities as required by the Contract Documents. Furnish copies of products test reports as required.

C. Furnish incidental labor and facilities to facilitate inspections and tests and for storage and curing of test samples.

D. Notify the lab sufficiently before operations to allow for laboratory personnel assignment and tests scheduling.

E. Make arrangements with lab and pay for additional samples and tests required for Contractor's convenience.

F. Contractor employed testing laboratory qualifications.


2. Be authorized to operate in the State of Tennessee.

G. Contractor employed testing laboratory duties and limitations of authority:

1. Perform specified inspections, sampling, materials testing and methods of construction testing and promptly submit an electronic copy of the written report of each test and inspection to the Designer.

2. Laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, approve or accept portions of the Work, or perform duties of the Contractor.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Provide structurally sound and neat temporary facilities and controls as necessary for the Work. Remove promptly as each is no longer required.

1.02 TEMPORARY OFFICE

Provide a temporary field office sized as necessary to support the Work. Adequate space and facilities shall be provided in the field office for convenient use and storage of contract drawings and specifications, approved shop drawings and field records. A telephone will be required.

1.03 TEMPORARY SHEDS

Provide watertight and secure storage sheds as necessary to hold materials to be protected while stored on the site.

1.04 TEMPORARY TOILET FACILITIES

Provide adequate temporary toilet and hand washing facilities for the use of all workers, conforming to all applicable laws, ordinances and regulations. Maintain these facilities in sanitary condition and remove upon completion of work.

1.05 TEMPORARY ENCLOSURES

A. Provide temporary weather tight enclosures or coverings for exterior openings in the building when required to permit the use of temporary heat or to protect the finished work from damage by the elements, and when necessary for security.

B. Provide temporary dust-tight partitions of plywood construction between the interior of new and existing buildings when work has progressed to the point where a new building is to be connected to an existing building, and in other locations as required by renovation work.

1.06 PROTECTION AND USE OF SITE

A. Maintain any existing site fencing. Provide and maintain all other fencing, planking, bridges, bracing, shoring, sheet piling, lights, barricades, warning signs and guards as necessary for the protection of persons, streets, sidewalks, landscaping, bridges, piers, buildings and property, both on and off the site, from construction related damage.

B. The Contractor shall confine site operations to areas designated for its use on the Drawings. The Contractor shall not interfere with the operations of surrounding buildings and shall not unreasonably clutter the site with materials or equipment.

C. Should any damage occur, Contractor shall restore such to its original condition in a manner acceptable to the Designer.

D. Take adequate precautions against fire. Keep flammable material at an absolute minimum, ensure that such material is properly handled and stored. Except as otherwise provided herein, do not permit fires to be built or open salamanders to be used in any part of the work.

E. The Contractor shall be responsible for maintaining site access and paying all highway fees.
F. The Contractor shall be responsible for repair of any damage resulting from the performance of the Work to lawns, pavement, sidewalks, curbs, streets, public utilities, and other public property. Repairs shall restore to the conditions existing prior to performance of the Work.

1.07 WATER AND SNOW CONTROL
A. Keep the site and the project free of accumulation of water and supply, maintain and operate all necessary pumping and bailing equipment.
B. Remove snow and ice as necessary for the protection and prosecution of the work, and protect the work against weather damage.

1.08 TEMPORARY HEATING
A. Provide heat, fuel and services as necessary to protect all work and materials against injury from dampness and cold until final acceptance of all work and material in the contract. The Contractor shall provide heat as follows:
   1. At all times during the placing, setting and curing of concrete, provide sufficient heat to ensure the heating of the space involved to not less than 50 degrees F unless otherwise approved.
   2. For a period of ten days and until final acceptance of the Work or until full occupancy, provide sufficient heat to maintain a temperature of not less than 60 degrees F.
B. Provide temporary heat by approved heating apparatus that will not endanger or damage work in place. Do not use unvented open flame heaters to heat or dry out freshly-placed concrete or plaster.
C. In remodeled areas where the existing heating system remains intact and functioning, replace all disposable filters, clean all permanent filters and clean any duct systems from accumulation of dust and dirt.

1.09 MAINTENANCE OF TRAFFIC AND CIRCULATION
Maintain circulation of traffic, both pedestrian and vehicular, and access to all parts of the site by fire-fighting apparatus during construction.

1.10 VERMIN CONTROL
During construction, the Contractor shall keep the building and the area of the construction free of food scraps and similar organic matter that would attract vermin, and it shall take measures necessary to prevent infestation of the building. If, at the time of final inspection or within six months after occupancy, the building is found to be infested by rodents or other vermin, the Contractor shall bear the expense of extermination.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
PART 1 - GENERAL

1.01 ENVIRONMENTAL, HAZARDOUS PRODUCTS, MATERIALS, OR WASTES

A. Do not incorporate in the Work hazardous materials or products as currently defined in the Resource Conservation and Recovery Act of 1976 (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), or Environmental Protection Agency (EPA) regulations, rules, or requirements, as amended, and/or State and local regulations, rules, or requirements that are equivalent or more stringent than the Federal regulations, rules, or requirements unless the Contract Documents give no other option than to provide a material or product that contains a hazardous material, component, constituent, waste, or leachate. In studying the Contract Documents and carrying out the Work, report at once to the Designer the discovery of a product or material that contains or is suspected to contain hazardous materials, components, constituents, waste, or leachate.

B. Do not incorporate in the Work a product or material that contains concentrations of a constituent, component, or material above the threshold levels which would require adherence to hazardous waste disposal regulations as currently defined, or could cause a release or threat of release of a hazardous substance at a level that would require a remedial response or removal action as currently defined by RCRA, CERCLA, or the EPA.

C. Select materials and products meeting specified requirements that comply with EPA requirements as regards hazardous materials content. In making requests for substitutions, determine that materials and products proposed for substitution comply with RCRA, CERCLA, and EPA requirements, and supply chemical constituent information and/or Material Safety Data Sheets (MSDS) with the substitution request.

1.02 TRANSPORTATION AND HANDLING

A. Materials, products and equipment shall be properly containerized, packaged, boxed and protected to prevent damage during transportation and handling.

B. More detailed requirements for transportation and handling are specified under the technical sections.

1.03 STORAGE AND PROTECTION

A. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.

B. On-site storage space is limited to the site. Acquisition of any additional off-site space is the responsibility of the Contractor.

C. Allocate the available storage areas and coordinate their use by trades. Maintain a current list showing all items and where they are stored.

D. Store and protect materials delivered to the site from damage. Do not use damaged material in the work.

1.04 INSTALLATION REQUIREMENTS

Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the respective manufacturers, unless otherwise specified.
01 60 00 – PRODUCT REQUIREMENTS

1.05 IDENTIFYING MARKINGS
Nameplates and other identifying markings shall not be affixed on exposed surfaces of manufactured items installed in finished spaces.

1.06 PRODUCT APPROVAL STANDARDS
A. Definitions:
   1. The term “product” shall include material, equipment, assembly methods, manufacturer, brand, trade name or other description.
   2. References to approved equal, approved substitution, or similar terms mean that Designer approval is required.

B. Proof of Compliance: Where the specifications require conformance with Federal specification, ASTM designation, ANSI specification or other association standard, the Contractor shall, where requested or specified, submit supporting test data to substantiate compliance.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
SECTION 01 73 00 - 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
9. Correction of the work

B. Related Requirements:

1. Section 01 10 00 "Summary" for limits on use of Project site.
2. Section 01 77 70 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
3. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.
4. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Concealed Spaces: Spaces which are not accessible after completion of construction.

B. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

C. Damage: Any sort of deterioration whether due to weather, normal wear and tear, accident, or abuse, resulting in soiling, marring, breakage, corrosion, rotting, or impairment of function.
D. Debris: Rubbish, waste, materials, litter, volatile wastes, and similar materials, with the exception of surplus materials which are to become the property of the Owner.

E. Operational Elements: Equipment, moving parts, electrical conductors, sound, and vibration control materials, water-proofing, vapor retarders, piping, ducts, tanks and other similar materials and components which convey or retard the passage of liquids, gases, heat, light, persons, animals, or insects or which perform a similar function not including structural elements.

F. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

G. Replacement: Restoration to completed condition by patching, repairing, refinishing, finishing, filing, closing up, and similar operations.

H. Safety Related Elements: Materials and elements whose principal function is the promotion of the safety of the building and its occupants, including fire and smoke barriers, fire proofing, emergency egress doors and windows, guardrails, equipment guards, and other similar construction.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor or professional engineer.

B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 5 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

   a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
E. Final Property Survey: Submit 1 original certified paper copy and one electronic pdf copy showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Plumbing piping systems.
   f. Mechanical systems piping and ducts.
   g. Control systems.
   h. Communication systems.
   i. Fire-detection and -alarm systems.
   j. Conveying systems.
   k. Electrical wiring systems.
   l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   a. Water, moisture, or vapor barriers.
   b. Membranes and flashings.
   c. Exterior curtain-wall construction.
   d. Sprayed fire-resistive material.
   e. Equipment supports.
   f. Piping, ductwork, vessels, and equipment.
   g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

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.

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. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. 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.

D. 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.

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 01 31 00 "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 or professional engineer 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 and Construction Manager 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.

D. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

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.

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 Substantial Completion.

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: Where possible, select tools or equipment that minimize production of excessive 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 portions of the 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. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 01 77 70 "Closeout Procedures" for repairing or removing and replacing defective Work.

K. 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. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. 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.

E. 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.

F. 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.

G. 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.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. 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 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
   2. Pre-installation Conferences: Include Owner's construction personnel at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   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 degrees 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 Substantial Completion.

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 Substantial Completion.

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 ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "Commissioning."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00
SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 02 41 16 "Structure Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
2. Section 02 41 19 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
3. Section 018114 High Performance Building Requirements (HPBr)
4. Section 04 20 00 "Unit Masonry" for disposal requirements for masonry waste.
5. Section 31 10 00 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

\[\text{PERFORMANCE REQUIREMENTS}\]

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the 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, including the following:

1. Demolition Waste:
   
a. Asphalt paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Brick.
e. Concrete masonry units.
f. Wood studs.
g. Wood joists.
h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.
n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
ee. Sprinklers.
ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.
kk. Lamps.
ll. Ballasts.
mm. Electrical devices.
nn. Switchgear and panelboards.
oo. Transformers.

2. Construction Waste:
   
a. Masonry and CMU.
b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet and pad.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

   1) Paper.
   2) Cardboard.
   3) Boxes.
   4) Plastic sheet and film.
   5) Polystyrene packaging.
   7) Plastic pails.

1.81.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.91.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. 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.

G. Qualification Data: For refrigerant recovery technician.

H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of 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.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

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 the entire duration of the Contract.
1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
   1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. 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, recycled, reused, donated, and sold.
   2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
   3. Store items in a secure area until installation.
   4. Protect items from damage during transport and storage.
   5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area off-site.
   5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

F. Plumbing Fixtures: Separate by type and size.
G. Lighting Fixtures: Separate lamps by type and protect from breakage.
H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 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 according to 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 the maximum extent practical according to approved construction waste management plan.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.
   2. Store components off the ground and protect from the weather.
   3. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
   1. Crush concrete and screen to comply with requirements in Section 31 20 00 "Earth Moving" for use as satisfactory soil for fill or subbase.
C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
   1. Pulverize masonry to maximum 3/4-inch size.
      a. Crush masonry and screen to comply with requirements in Section 31 20 00 "Earth Moving" for use as satisfactory soil for fill or subbase.
   2. Clean and stack undamaged, whole masonry units on wood pallets.
D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
E. Metals: Separate metals by type.
   1. Structural Steel: Stack members according to size, type of member, and length.
   2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

I. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
   1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

K. Carpet Tile: Remove debris, trash, and adhesive.
   1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

L. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

M. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   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 Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
a. Comply with requirements in Section 32 93 00 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container 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.

   a. Comply with requirements in Section 32 93 00 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

   1. Except as 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: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.
THIS PAGE INTENTIONALLY LEFT BLANK
PART 1 - GENERAL

1.01 PRE-CLOSEOUT SUBMITTALS

A. Submit required tabulations when Work reaches seventy-five percent completion; however, regardless of percent completion, submit not later than 30 days prior to the scheduled date on which Substantial Completion is required.

B. Submit tabulations of the following.
   1. Equipment and systems for which the specifications require demonstrations or training, indicating relevant specification sections, scheduled time and place for demonstration and training sessions, and intended audience. Adjust schedule if instructed by Designer to do so.
   2. Equipment and systems for which operating and maintenance data are required in the Operating and Maintenance Data Binders and related documents are required in the Project Data Binders.
   3. Spare parts and extra materials required, indicating the relevant specification sections, and the appropriate party to whom the items are to be delivered.

1.02 REQUEST FOR CLOSEOUT INSPECTION

A. Substantial Completion: When Contractor considers Work substantially complete, Contractor shall submit the following to Designer.
   1. Written assertion that Work is Substantially Complete
   2. A list of items to be completed or corrected and dates scheduled for completion or correction of each item
   3. Certification that orientation and training for facility maintenance personnel is complete or written assertion that such orientation and training will be certified prior to inspection
   4. Written assertion that Operating & Maintenance Data Binders are complete and available or will be prior to inspection
   5. When a Use and Occupancy Permit applies, a copy of the final approval(s), or written assertion that they will be complete and available prior to inspection
   6. A draft of the application for payment corresponding to the Substantial Completion, with written assertion that an application for payment will be ready and submitted at the inspection
   7. When there is Commissioning, written assertion that Commissioning requirements have been completed or will be prior to inspection
   8. When there is a storm water permit, written statement of the status of final stabilization required under the Storm Water Pollution Prevention Plan (SWPPP) for the TDEC Construction General Permit (CGP) Notice of Termination (NOT).

B. Final Inspection: When Contractor considers Work complete, Contractor shall submit the following to Designer.
   1. Certification that a qualified person authorized by Contractor has reviewed the Contract Documents and inspected the Work
   2. Written assertion that the Work is complete and in accordance with Contract Documents and ready for Final Inspection
3. Written assertion that additional materials necessary to augment the Operating & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and available or will be prior to inspection

4. Written assertion that Project Data Binders and Construction Record Documents are complete and available or will be prior to inspection

5. An application for final payment

C. Upon receipt of an appropriate request for inspection, Designer will schedule an inspection meeting with Contractor, and Owner’s representatives to determine the status of completion.

1.03 RESULTS OF CLOSEOUT INSPECTIONS

A. Should the Designer determine that Work is not complete to the degree asserted by Contractor, Designer will promptly notify Contractor in writing stating the deficiencies. Contractor shall take immediate steps to remedy deficiencies and make a request for Re-Inspection.

B. Substantial Completion: Designer will prepare a Certificate of Substantial Completion accompanied by a list of items to be completed or corrected, and will submit Certificate to Contractor and to Owner for signature with an accounting of Liquidated Damages due, when Designer verifies the following.
   1. Work is Substantially Complete based on an inspection conducted pursuant to an appropriate request for Closeout inspection
   2. Orientation and training for facility maintenance personnel is complete
   3. Operating & Maintenance Data Binders are complete and have been delivered to the Owner

C. Final Inspection: Designer will certify that the Work is Complete, and will initiate Final Adjustments, when Designer verifies the following.
   1. Work is complete in accordance with Contract Documents based on an inspection conducted pursuant to an appropriate request for Closeout inspection
   2. Orientation and training for facility maintenance personnel is complete
   3. Additional materials necessary to augment the Operating & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and have been delivered to the Owner
   4. Project Data Binders and Construction Record Documents are complete and have been delivered to the Designer.

1.04 RE-INSPECTION FEES:

If the Work fails a Closeout inspection, and a subsequent inspection is requested and conducted based on Contractor assertion of the same stage of completion, Owner will compensate Designer for performing such re-inspection as additional services, and deduct the amount of such compensation from the Contract Sum by appropriate modification.

1.05 FINAL ADJUSTMENTS

A. When Designer has certified that the Work is complete, Designer will determine whether modification is needed to reflect appropriate adjustments to Contract Sum
which were not previously effected. If such modification is needed, Designer shall assist the Owner in its preparation and deliver it to Contractor, who in the case of a change order, shall sign and return it to Designer.

B. When Designer has certified that the Work and needed modifications to the Contract are complete, and if necessary, Designer will instruct Contractor to submit a revised final application for payment.

1.06 ONE-YEAR CORRECTIVE INSPECTION

A. An inspection will be scheduled and conducted at project site prior to one year from date Substantial Completion was achieved, but as close to the end of that year as is reasonably possible.

B. The inspection will be attended by at least one representative each of Owner, Designer, and Contractor.

C. The inspection will confirm non-conforming items previously identified for correction by the Owner, and whether corrections have been completed or are still outstanding, and is intended to be an opportunity for Contractor to become aware of any outstanding corrections needed.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
PART 1 - GENERAL

1.01 DATA BINDERS, GENERAL REQUIREMENTS

A. Provide two complete sets on paper in three ring binders and a complete set in PDF format. Identify project and type of data on face and saddle. If multiple binders are required, identify as consecutively numbered volumes, identifying original documents as set number one and include a table of contents in each binder.

B. Provide information required by Contract Documents organized as outlined below. Include related documents under the heading to which each is most closely related.

C. Provide introductory information:
   1. Cover sheet giving complete project title and number, Contractor's name, address, phone number, superintendent's name, and related information.
   2. Table of Contents identifying material in Binder, and identifying missing materials to be added later or certifying completeness of Binder. Reference and bind separately any over-size documents that cannot be neatly folded and included in this binder.

1.02 OPERATING & MAINTENANCE DATA BINDERS

A. Provide Product Data as outlined below
   1. Detailed Table of Contents for this part
   2. For each system or product: names, addresses, and telephone numbers of supplier, installer, and maintenance service company; drawing and specification reference; building location; manufacturer and model number
   3. Description of unit and component parts, clearly identifying the specific product or part installed. When manufacturer's cut sheets are used for product identification, plainly mark specific items included in Work and mark out items not included in Work.
   4. Related information required by Contract Documents, or furnished with items included in Project, that Owner may use for maintenance, operation, repair, renovation, or additions to Work.

B. Provide Operating and Maintenance Data as outlined below for mechanical and electrical systems, equipment, and products:
   1. Detailed Table of Contents for this part
   2. Manufacturer's printed operating and maintenance instructions supplemented with drawings and text to clearly illustrate proper operation and a logical sequence of maintenance procedures.
   3. Servicing and lubrication schedule with list of lubricants.
   4. Manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
   5. As-installed control diagrams by controls manufacturer.
   6. Installers' coordination drawings with as-installed color coded piping diagrams and wiring diagrams.
   7. Charts of valve tag numbers with the location and function of each valve.
8. Circuit directories of panel boards.
9. Instructions for care, with a list of manufacturer's recommended types of cleaning agents and methods.
10. List materials and parts furnished for the Owner's use.
11. Copy of the list of persons who received demonstration and training.

C. If Commissioning applies, provide a section for the Commissioning functional performance test certifications and data. If separate binders of this information have been submitted already, include a copy of their content in this section. If separate binders of this information have not been submitted already, provide a third copy in a separate binder.

D. If a SWPPP applies, provide a section into which the Designer can add the Storm Water Operation & Maintenance Plan.

1.03 PROJECT DATA BINDERS

A. On the form exhibited as Section 01 78 88, provide required information for general contractor and all subcontractors and major material suppliers.

B. Provide certificates and acceptance information:
   1. Detailed Table of Contents for this part
   2. Certificate of Substantial Completion
   3. A copy of the State Fire Marshal's Certificate of Occupancy, if applicable
   4. Other Certificate(s) of Inspection, Use & Occupancy permit, or letter(s) of acceptance from:
      a. Local building authorities
      b. Department of Labor for boilers, pressure vessels, or elevators
      c. Public Health Authorities
      d. other governing authorities as apply

C. Guarantees, warranties, bonds, certifications, maintenance agreements, and related documents
   1. Detailed Table of Contents for this part
   2. Guarantees, warranties, and bonds, executed by the respective vendors, manufacturers, suppliers and subcontractors
   3. Certifications
   4. Maintenance Agreements and service contracts
   5. Complete information for each item:
      a. Product or work item, and scope of installation
      b. Name of provider, with name of responsible principal, address and telephone number
      c. Beginning date and duration
d. Information about instances which might affect validity, and proper procedure in case of failure

D. If a SWPPP applies, provide the twice-weekly inspection reports and site audit reports.

1.02 CONSTRUCTION RECORD DOCUMENTS

Keep the record copy of Contract Documents required by the Conditions in good condition and in the course of the Work, legibly mark these to record actual conditions of Work, including: location, depth, and identification of new and existing underground items, utilities, valves, tap points, equipment, service access, test points, and related features; field changes in dimensions and detail; changes by addenda or Modification; and, description and details of features for maintenance, service, replacement, or expansion of the Work.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
SECTION 01 78 23 - 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 manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 01 91 13 "Commissioning" for verification and compilation of data into operation and 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. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
B. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. 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: Bookmark 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.

B. 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, and indicate Specification Section number on bottom of spine. 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. Enclose title pages and
directories in clear plastic sleeves.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

   a. 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.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: 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.

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 Construction Manager @ Risk.
   6. Name and contact information for Architect.
   7. Name and contact information for Commissioning Authority.
   8. Names and contact information for major consultants to the Architect that designed the
      systems contained in the manuals.
   9. 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. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with the 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."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of a system, list alphabetically in separate lists.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by the Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
5. Power failure.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of the Owner's operating personnel for notification of the Installer, supplier, and manufacturer to maintain warranties.
E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.
D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of maintenance manuals.
1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Color, pattern, and texture.
   5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823
PART 1 - GENERAL

1.01 CONTRACTOR PREPARATION AND USE OF THIS FORM

A. Use this form or a reasonable facsimile to verify delivery of Data Binders. Fill in the identifying information following this paragraph, then use the prepared form as a receipt, for signature by the person to whom Data Binders are delivered. Provide a copy of the receipt with the Application for Payment.

1. For the Application for Payment commensurate with Substantial Completion, provide a copy indicating delivery of Operating and Maintenance Data Binders.

2. For the Application for Payment commensurate with Final Completion, provide a copy indicating delivery of Project Data Binders.

B. Identifying Information:

1. For the Work:

   Project Name: VA Campus Building 2 First Floor Renovation
   Institution: East Tennessee State University
   Location: Johnson City, Tennessee
   SBC No.: 369/005-06-2020

2. For the Data Binder(s), mark only one of the boxes below:

   [ ] Only Operating & Maintenance Data Binder
   (due at substantial completion inspection)

   [ ] Only Project Data Binder
   (due at final inspection)

   [ ] Both Data Binders

1.02 RECIPIENT SIGNATURE

A. By signature below, recipient acknowledges receipt of the Data Binder identified above, but does not certify the completeness or correctness of the Data Binder.

   Recipient Signature:

   Recipient’s name and title or affiliation with Owner or Designer

PART 2 – PRODUCTS (Not Used)
PART 3 – EXECUTION (Not Used)

END OF SECTION
SECTION 01 78 39 - 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.

B. Related Requirements:

1. Section 01 73 00 "Execution" for final property survey.
2. Section 01 77 70 "Closeout Procedures" for general closeout procedures.
3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:

   a. Initial Submittal:
      1) Submit PDF electronic files of scanned record prints.
      2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

   b. Final Submittal:
      1) Submit PDF electronic files of scanned record prints and one set of prints.
      2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
C. Record Product Data: Submit one annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 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 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.
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. Electronic Submittal Requirement

1. All drawings are to be submitted in AUTOCAD format, in the current version that the drawings are created or previous examples. Subcontractors shall provide CADD files to the design team for use in preparation of record drawings showing actual location of items that were changed during construction.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.


3. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect.
   e. Name of General Contractor

1.5 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 scanned PDF electronic file(s) of marked-up paper copy of Specifications.
1.6 RECORD PRODUCT DATA

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. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, record Specifications, and record Drawings where applicable.

C. Format: Submit record Product Data as scanned PDF electronic file of Product Data.

   1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file of marked-up miscellaneous record submittals.

   1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store record documents 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.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 78 39
PART 1 - GENERAL

1.01 REQUIREMENTS
Submit required reports of subcontractors and suppliers on forms similar to the example herein or on forms with equivalent content and detail.

1.02 EXAMPLE REPORT

<table>
<thead>
<tr>
<th>Project: VA Campus Building 2 First Floor Renovation</th>
<th>SBC No. 369/005-06-2020</th>
<th>General Contractor Name, Address, Phone, and Principal Contact:</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Contractor Diversity-Owned?</td>
<td></td>
<td>Diversity-Owned Business?</td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td>If “Yes”, provide classification and certifying agency.</td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
</tbody>
</table>

Continue report as required on additional pages. Page ___ of ___.

END OF SECTION
PART 1 – GENERAL

1.01 DEMONSTRATION AND TRAINING

A. Coordinate a schedule of demonstration and training with Designer and Owner’s personnel for all installed equipment and systems.

B. Conduct demonstration and instruction as soon as practicable upon installations, and prior to Substantial Completion inspection. Substantial Completion shall not be certified, nor shall Owner be required to assume responsibility for operating, maintaining, or insuring system, prior to complete demonstration and instruction.

C. If conditions (such as season of year) do not allow for a complete demonstration or training of equipment and systems operation during one meeting session prior to Substantial Completion; then coordinate a schedule that shall provide a sufficient number of sessions within the warranty period.

D. Demonstrate operation of installed equipment and systems to Designer and to Owner’s representative. All dependent systems must be demonstrated as being operationally coordinated, e.g. energy management controls coordinated with mechanical equipment.

E. Demonstrations shall be complete and detailed; referencing manufacturer’s printed O&M instructions and evidencing all required design specifications.

F. All training shall be specific to the actual installed equipment and systems, and be performed by persons approved by equipment manufacturer(s) and/or approved by the Designer to conduct such training.

G. Instruct Owner’s personnel with overall equipment and systems assembly and function; using assembly drawings and diagrams which are specific to the actual installed equipment and systems.

H. Instruct Owner’s personnel in operation, adjustment, and maintenance of equipment and systems; using the manufacturer’s printed operating and maintenance data that is specific to the installed equipment and systems as the basis of instruction.

I. Verify that Owner’s personnel have received all spare materials and parts required to be furnished, and provide instruction in replacement procedures.

J. Make lists of persons witnessing equipment and systems demonstration, and persons receiving operating instruction, using a format similar to the form included in section 01 79 25 with project, subject, trainer, session information, and attendees identified. Include copy of lists in the Operating and Maintenance Data Binders.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION
PART 1 - GENERAL

1.01 INSTRUCTIONS

A. Use a copy of this page as a planning form for demonstrations and training. Fill in the basic identifying information below:

<table>
<thead>
<tr>
<th>SBC Project Number:</th>
<th>369/005-06-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institution/Location:</td>
<td>East Tennessee State University / Johnson City, Tennessee</td>
</tr>
<tr>
<td>Project Name:</td>
<td>VA Campus Building 2 First Floor Renovation</td>
</tr>
<tr>
<td>Owner's Facility Coordinator:</td>
<td></td>
</tr>
<tr>
<td>Owner's Maintenance Contact:</td>
<td></td>
</tr>
<tr>
<td>Contractor Contact:</td>
<td></td>
</tr>
</tbody>
</table>

B. If a list of required demonstrations and training has been specified in Division 1, use that list as a starting point, review the project manual for other specifications that require training of the Owner's operators, and complete the list below. Check the box on left if Demonstration and Training is required on the standard listed subjects; add subjects as identified by review of the specifications and check the box to the left of each; and, schedule and indicate a target date for each. If the number of training subjects exceeds the available space provided here, replace or continue the list on a similarly formatted separate page. Submit the list with the initial Progress Schedule, and update as necessary during the Work to ensure that advance notice of the demonstration and training schedule is acceptable to the Designer.

<table>
<thead>
<tr>
<th>Spec Reference</th>
<th>Subject</th>
<th>Target Date</th>
<th>Actual Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiler</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chiller</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Transmission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevator / Conveying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Alarm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plumbing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telecommunications</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.02 TRAINING VERIFICATION REPORT

For each session conducted, use this page as a training verification report. Fill in the information below prior to the session. “End Time” may be filled in after.

<table>
<thead>
<tr>
<th>SBC Project Number:</th>
<th>369/005-06-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institution/Location:</td>
<td>East Tennessee State University / Johnson City, Tennessee</td>
</tr>
<tr>
<td>Project Name:</td>
<td>VA Campus Building 2 First Floor Renovation</td>
</tr>
</tbody>
</table>

Subject Equipment / System:

<table>
<thead>
<tr>
<th>Spec Reference</th>
</tr>
</thead>
</table>

Demonstration and Training (by whom, where, when)

<table>
<thead>
<tr>
<th>Trainer Name:</th>
<th>Company:</th>
<th>Phone:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place:</td>
<td>Date:</td>
<td>Start Time:</td>
</tr>
</tbody>
</table>

A. Minimum Agenda Requirements:

- [ ] System Walk-through
- [ ] Operation
- [ ] Troubleshooting
- [ ] Maintenance
- [ ] Safety

B. Attendance: Each person receiving the demonstration and training shall sign in below, or on a similarly formatted continuation page:

<table>
<thead>
<tr>
<th>Initials</th>
<th>Legibly print your name</th>
<th>Unit and title or function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 – GENERAL

1.01 DESCRIPTION

A. The State of Tennessee High Performance Building Requirements (HPBr) is an Office of the State Architect (OSA) program acknowledged by the State Building Commission (SBC) whose goal is to provide a minimum standard of high performance building attributes for Designers and Contractors. It is to be used as a mandatory design, construction, and operations tool for all SBC projects including new construction, additions, and renovation / maintenance.

B. The Designer and Owner have selected materials and utilized integrated design processes that achieve the State of Tennessee’s objectives for high performance buildings. The Contractor is responsible for maintaining and supporting these objectives in developing means and methods for performing work and in proposing product substitutions or changes to specified processes.

C. A copy of the Checklist/Tracking Form worksheet is found as an attachment to this section which summarizes the HPBr credits intended to be achieved.

D. The Contractor shall review the project-specific Checklist/Tracking Form worksheet for those credits for which the Contractor has a responsibility in achieving. The Contractor shall respond to the Designer and the Owner regarding credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor’s procedures. Contractor shall document responses as informational submittals. Contractor shall inform Designer and/or Owner where credit applicability is questionable or where pursued credits may not be achieved. The Contractor shall also inform the Designer and Owner of credits which are achievable but are not shown as being pursued in the checklist.

1.02 RELATED WORK

A. Section 01 33 00 Submittal Procedures

B. MR2.1 – Construction Waste Management
   1. Identify the target diversion rate within the Construction Waste Management Plan in Section 01 74 19 (75%).
   2. Require the Contractor to track the overall waste diversion rate throughout construction and provide a submittal for the final achieved diversion rate.

C. MR3.1 – Sustainable Materials: Recycled content
1. Give preference to materials that are high in Recycled Content, such that at least 10 percent (based on cost) of building materials is recycled (excludes MEP equipment cost).

2. Research synthetic gypsum board for use in construction when appropriate.

D. EQ6 – Material VOC Limits

1. The Volatile Organic Compounds (VOC) content of Adhesives, sealants, and paints / coatings used must not exceed the limits established within Part 2 for interior products (those inside the weather barrier).

2. Contractor to meet or exceed (VOC limits lower than the amounts outlined in Part 2) the VOC content limits of Adhesives, sealants, paints / coatings, flooring systems, composite wood and agrifiber products.

3. EQ6.1 – Material VOC Limits: Sealants
   a. VOC-compliant sealants
      i. Section 07 84 00 Firestopping
      ii. Section 07 92 00 Joint Sealants

4. EQ6.2 – Material VOC Limits: Paints
   a. VOC-compliant interior paints and coatings
      i. Section 09 91 23 Interior Painting

5. EQ6.4 – Material VOC Limits: Flooring systems
   a. Give preference to carpet systems that meet or exceed the requirements of the Carpet and Rug Institute’s Green Label Plus Indoor Air Quality Test Program.
   b. Give preference to carpet cushion installed in the building interior that meets the requirements of the Carpet and Rug Institute Green Label program.
   c. Give preference to hard surface flooring that meets the testing and product requirements of FloorScore certification.
   d. Tile, masonry, terrazzo, cut stone and solid wood flooring without coatings or sealant qualify for credit without testing.
   e. Carpet complying with CRI Green Label Plus requirements and installation materials complying with CRI Green Label requirements and VOC-limits. Include a reference to FloorScore certification by Resilient Floor Covering Institute (RFCI) in conjunction with Scientific Certification Systems (SCS).
      i. Section 09 68 00 Carpeting
      ii. Section 09 68 13 Carpet Tile
6. EQ6.5 – Material VOC Limits: Composite Wood and Agrifiber products
   a. Specify products that contain no added Urea-formaldehyde resins.

E. EQ7.2 – Pollutant Control: Hazardous material storage
   1. Door closers at rooms where hazardous gases or chemicals may be present,
      including copy/print rooms
      a. Section 08 71 00 Door Hardware

1.03 DEFINITIONS

A. Addition – an increase in floor area of a building outside of the existing building
   envelope.

B. Adhesive - A substance used to bond two surfaces together by attachment.
   Adhesives include all bonding and adhesive primers.

C. Brownfield – Property with the potential presence of hazardous substances,
   pollutants or contaminants which may complicate redevelopment efforts. See also
   www.epa.gov/brownfields.

D. Formaldehyde - Formaldehyde is a naturally occurring volatile organic compound
   which is carcinogenic and an irritant when present in relatively high concentrations. It
   has been known to cause headaches, dizziness, mental impairment, and other
   symptoms. When present in air at levels above 0.1 ppm (parts per million), it may
   cause watery eyes, burning sensations in the eyes, nose, and throat; nausea;
   coughing; chest tightness; wheezing; skin rashes; as well as asthmatic and allergic
   reactions.

E. Indoor Air Quality - The quality of air inside a space or building. Indoor air quality
   affects the health and well-being of building occupants.

F. Light Pollution - Waste light from building sites and lighting installations produces
   glare, when directed upward or off site.

G. Outdoor Air - The ambient air that enters a building through a ventilation system,
   through intentional openings for natural ventilation, or by infiltration.

H. Permanently Installed Building Product - products and materials that create the
   building or are permanently attached to it. Examples include structure and enclosure
   elements, installed finishes, framing, interior walls, cabinets and casework, doors,
   and roofs. Most of these materials and products fall within CSI 2012 MasterFormat
   Divisions 3-10, 31, and 32.

I. Recycled Content - Recycled Content of materials is defined according to Federal
   Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR
Recycled Content value of a material assembly is determined by weight. Recycled fraction of assembly is multiplied by cost of assembly to determine Recycled Content value.

1. "Post-Consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

2. "Pre-Consumer" material is defined as material diverted from waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

J. Regional Materials - Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of project site. If only a fraction of a product or material is extracted or harvested or recovered and manufactured locally, then only that percentage (by weight) must contribute to regional value.

K. Rapidly Renewable Material - Building materials and products which are made from plants that are typically harvested within a 10—year or shorter cycle.

L. Salvaged or Reused Materials - Construction materials recovered from existing buildings or construction sites and reused. Common Salvaged Materials include structural beams and post, flooring, doors, cabinetry, brick, and decorative items.

M. Sealant - Any adhesive with properties that have been specifically formulated to fill, seal, or waterproof gaps or joints between two surfaces. These may include primers and caulks.

N. Solar Reflectance Index (SRI) - SRI is the measure of a material’s ability to reject solar heat. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. Once the maximum and minimum temperature rises of a given material have been computed, the SRI can be found by interpolating between the values for white and black. Materials with the highest SRI values are the coolest choices. Due to the way SRI is defined a relative scale, particularly hot materials may have slightly negative values, and particularly cool materials can sometimes exceed 100. (Lawrence Berkeley National Laboratory Cool Roofing Materials Database)

O. Urea Formaldehyde - A combination of urea and formaldehyde that is used in some adhesives and will sometimes emit formaldehyde at room temperature.
Volatile Organic Compounds (VOC) - Chemicals that are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

1.04 REFERENCES

A. Tennessee High Performance Building Requirements (HPBr) can be found within the Office of the State Architect’s page on the following website (includes the Manual, HPBr Workbook, Owner’s Project Requirements, FAQ Guide, and Quick Start Guide): https://www.tn.gov/content/tn/osa/capital---real-estate/capital-projects/high-performance-building-requirements--hpbr-.html


1.05 SUBMITTALS

A. Product submittals to be provided with manufacturer documentation in accordance with Section 01 33 00 Submittal Procedures:

   a. Manufacturer’s product data with percentages of sustainable materials, by cost, used to calculate compliance with Materials & Resource credits. Note that credits MR3.6 Salvaged Material and MR3.7 Rapidly Renewable Materials are based on dollar amounts rather than percentage costs.

2. EQ5.1 – Air Quality Management: During Construction.
   a. If permanently installed air handling units are used during construction, provide manufacturer’s cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles.
   b. If ANSI/SMACNA 008-2008, Chapter 3 approaches are employed, take a minimum of 18 construction photographs including six photographs taken on three different occasions during construction along with a brief description of each approach, documenting implementation of IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.

3. EQ6.1, EQ6.2, EQ6.3, EQ6.4, EQ6.5 – Material VOC Limits. Manufacturer’s product data including VOC content for all adhesives, sealants, paints / coatings,
flooring systems, and urea-formaldehyde content of composite wood / agrifiber materials within the weather barrier.

B. As requirement for Final Payment, Contractor shall provide additional closeout submittals as follows:
1. MR2.1 – Construction Waste Management. Waste hauler provided construction waste reports verifying level of diverted waste or salvaged material for the project.
2. MR3.1, MR3.2 – Sustainable Materials. Materials and Resources Calculator, (found within the Checklist Workbook) verifying calculated Recycled Content (pre-consumer and post-consumer), regional content, resource reuse / material reuse, Rapidly Renewable Materials, and Tennessee-based material content (excluding MEP equipment).
3. EQ5.1 – Air Quality Management: During construction. Filter change log showing filters are replaced prior to occupancy
4. Signed Credit Verification Form found within the HPBr Workbook

PART 2 – PRODUCTS

2.01 PERFORMANCE CRITERIA

A. MR2.1 - Construction Waste Management. No less than 75 percent or more waste material (excluding soil, by weight volume) from construction has been diverted from the landfill to be salvaged or recycled.
1. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
2. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

B. MR3.1 and MR3.2 – Sustainable Materials: Recycled content. Not less than 20 percent of building materials (by cost, excluding MEP equipment) must contain Recycled Content. For the purposes of documenting credit compliance, pre-consumer recycled content is only worth half of the value of post-consumer recycled content.
### 2.02 VOC Limit Table

<table>
<thead>
<tr>
<th>EQ Table – Material VOC Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural Adhesives (g/L less water):</td>
</tr>
<tr>
<td>a. Indoor Carpet:</td>
</tr>
<tr>
<td>b. Carpet Pad:</td>
</tr>
<tr>
<td>c. Wood Flooring</td>
</tr>
<tr>
<td>d. Rubber Floor:</td>
</tr>
<tr>
<td>e. Subfloor:</td>
</tr>
<tr>
<td>f. Ceramic Tile:</td>
</tr>
<tr>
<td>g. VCT &amp; Asphalt:</td>
</tr>
<tr>
<td>h. Drywall &amp; Panel:</td>
</tr>
<tr>
<td>i. Cove Base:</td>
</tr>
<tr>
<td>j. Multipurpose:</td>
</tr>
<tr>
<td>k. Structural Glazing:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialty Adhesives (g/L less water):</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. PVC Welding:</td>
</tr>
<tr>
<td>b. CPVC Welding:</td>
</tr>
<tr>
<td>c. ABS Welding:</td>
</tr>
<tr>
<td>d. Plastic Cement:</td>
</tr>
<tr>
<td>e. Primer for Plastic:</td>
</tr>
<tr>
<td>f. Contact:</td>
</tr>
<tr>
<td>g. Special Purpose Contact:</td>
</tr>
<tr>
<td>h. Structural Wood Member:</td>
</tr>
<tr>
<td>i. Sheet Applied Rubber:</td>
</tr>
<tr>
<td>j. Top &amp; Trim:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Substrate Specific (g/L less water):</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Metal to Metal:</td>
</tr>
<tr>
<td>b. Plastic Foams:</td>
</tr>
<tr>
<td>c. Porous Material (except wood):</td>
</tr>
<tr>
<td>d. Wood:</td>
</tr>
<tr>
<td>e. Fiberglass:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sealants (g/L less water):</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Architectural:</td>
</tr>
</tbody>
</table>
b. Architectural Porous: 775

Non-membrane Roof: 300

Roadway: 250

Single-Ply Roof Membrane: 450

Other: 750

g. Aerosol General Purpose mist spray: 65% VOCs by weight

h. Aerosol General Purpose web spray: 55% VOCs by weight

i. Aerosol Special Purpose: 70% VOCs by weight

Paints (g/L less water):

a. Flats: 50

b. Non-Flats 50

Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates:

a. VOC limit is (g/L less water): 250

Coatings (g/L less water)

a. Clear wood finish, varnish: 350

b. Clear wood finish, lacquer: 550

c. Floor coatings: 100

d. Sealers and undercoaters: 200

e. Shellac, clear: 730

f. Shellac, pigmented: 550

g. Stain: 250

PART 3 – EXEUCTUION

3.01 SPECIAL REQUIREMENTS

A. EQ5.2 Construction Indoor Air Quality Management additional requirements, the Contractor shall develop and implement an Indoor Air Quality Management plan for the pre-occupancy phase as follows:

1. Option 1 – Flush-out: After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of Outdoor Air per sq.ft. of floor area while maintaining an internal temperature of between 80 and 60 degrees F and relative humidity no higher than 60%.
01 81 14 – TN HIGH PERFORMANCE BUILDING REQUIREMENTS

a. If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 3,500 cu.ft. of Outdoor Air per sq.ft. of floor area to the space. Once a space is occupied, it shall be ventilated per the design minimum outside air rate determined from ASHRAE 62.1-2007 or the 2012 IMC.

b. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions must be maintained until a total of 14,000 cu.ft./sq.ft. of outside air has been delivered to the space.

3.02 ATTACHMENTS

A. Tennessee HPBr Checklist/Tracking Form
B. Tennessee HPBr Credit Verification Form
C. Tennessee HPBr Materials and Resources Calculator

END OF SECTION 01 81 14
### High Performance Building Requirements - 5/18/18

#### CHECKLIST / TRACKING FORM

<table>
<thead>
<tr>
<th>Phase</th>
<th>Points Summary</th>
<th>SBC Number</th>
<th>Project Name</th>
<th>Project Type</th>
<th>Minimum</th>
<th>Project Phase</th>
<th>Category from</th>
<th>Category C</th>
<th>Applicability Type</th>
<th>Compliance Check</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming</td>
<td>30</td>
<td>239 005 06 2020</td>
<td>ETSU Building #2</td>
<td>Renovation/Maintenance</td>
<td>27</td>
<td>Construction Documentation</td>
<td>C</td>
<td>C</td>
<td>Applicable</td>
<td>Project Completes with the HPBr</td>
<td></td>
</tr>
</tbody>
</table>

#### Priority 2

- **High Performance Building Requirements - 5/18/18**

#### CHECKLIST / TRACKING FORM

<table>
<thead>
<tr>
<th>Possible Points</th>
<th>Credit ID</th>
<th>Applicable to Building/Site Scope?</th>
<th>Description</th>
<th>Level:</th>
<th>Project Team Representatives Initials</th>
<th>Primary Credit Responsibility</th>
<th>Role</th>
<th>Initiates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LM2.2</td>
<td>Yes</td>
<td>Site Selection - Reuse Existing Buildings</td>
<td>Priority 2</td>
<td>O - Owner CM</td>
<td>CE - Contractor TBD</td>
<td>WV - Mechanical Engineer TBD</td>
<td>MD - Electrical Engineer TBD</td>
</tr>
</tbody>
</table>

#### Priority 1

- **High Performance Building Requirements - 5/18/18**

#### CHECKLIST / TRACKING FORM

<table>
<thead>
<tr>
<th>Possible Points</th>
<th>Credit ID</th>
<th>Applicable to Building/Site Scope?</th>
<th>Description</th>
<th>Level:</th>
<th>Project Team Representatives Initials</th>
<th>Primary Credit Responsibility</th>
<th>Role</th>
<th>Initiates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LM2.2</td>
<td>Yes</td>
<td>Site Selection - Reuse Existing Buildings</td>
<td>Priority 1</td>
<td>O - Owner CM</td>
<td>CE - Contractor TBD</td>
<td>WV - Mechanical Engineer TBD</td>
<td>MD - Electrical Engineer TBD</td>
</tr>
</tbody>
</table>

#### Help Notes:

1. Retain from copying and pasting data in Column C. "Applicable to Building Site Scope?" as this can cause errors in some rows.
2. If any cell highlights red then you have a point allocated to a credit that is "not applicable." This is an error. Simply delete the contents of the cell to reset.
3. If column C if you have copied or pasted in this column and a cell that credit as "not applicable" and points cannot be attempted.

#### Programing

- **High Performance Building Requirements - 5/18/18**

#### CHECKLIST / TRACKING FORM

<table>
<thead>
<tr>
<th>Possible Points</th>
<th>Credit ID</th>
<th>Applicable to Building/Site Scope?</th>
<th>Description</th>
<th>Level:</th>
<th>Project Team Representatives Initials</th>
<th>Primary Credit Responsibility</th>
<th>Role</th>
<th>Initiates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LM2.2</td>
<td>Yes</td>
<td>Site Selection - Reuse Existing Buildings</td>
<td>Priority 1</td>
<td>O - Owner CM</td>
<td>CE - Contractor TBD</td>
<td>WV - Mechanical Engineer TBD</td>
<td>MD - Electrical Engineer TBD</td>
</tr>
</tbody>
</table>
## High Performance Building Requirements - 5/18/18

### CHECKLIST / TRACKING FORM

<table>
<thead>
<tr>
<th>Phase</th>
<th>Points Summary</th>
<th>SBC Number</th>
<th>Project Name</th>
<th>Date</th>
<th>Priority</th>
<th>Requirement</th>
<th>Project Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programing</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category from</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compliance Check</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Complies with the HPBr:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Helpful Hints:
1) Refrain from copying and pasting data in Column C, "Applicable to Building/Site Scope?" as this can cause errors in some rows.
2) If any cell highlights red below, then you have a point allocated to a credit that is "not applicable." This is an error. Simply delete the contents of the cell to reset.
3) In column C, if you have copied or pasted in this column and a cell highlights all red, delete the contents of that cell to correct the error.
4) If no points are available in the dropdown, this means you have listed that credit as "not applicable" and points cannot be attempted.

#### Possible Points

<table>
<thead>
<tr>
<th>Credit ID</th>
<th>Credit ID</th>
<th>Applicable to Building/Site Scope?</th>
<th>Description</th>
<th>Level</th>
<th>Priority</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME</td>
<td>1</td>
<td>Yes</td>
<td>Commissioning - Basic commissioning process</td>
<td>Required</td>
<td>1</td>
<td>CxA</td>
</tr>
<tr>
<td>ME</td>
<td>2</td>
<td>Yes</td>
<td>Energy Efficient Purchasing Policy - Energy Star qualified appliances &amp; equipment</td>
<td>Required</td>
<td>1</td>
<td>CM</td>
</tr>
<tr>
<td>ME</td>
<td>3</td>
<td>Yes</td>
<td>Energy Efficiency - Life Cycle Cost Analysis</td>
<td>Required</td>
<td>1</td>
<td>Other</td>
</tr>
<tr>
<td>ME</td>
<td>4</td>
<td>Yes</td>
<td>Minimum Energy Performance - all projects to demonstrate compliance with ASHRAE 90.1-2010, according to project scope</td>
<td>Required</td>
<td>1</td>
<td>Other</td>
</tr>
<tr>
<td>ME</td>
<td>5</td>
<td>No</td>
<td>Compliant with OBC</td>
<td>No</td>
<td>0</td>
<td>Other</td>
</tr>
<tr>
<td>ME</td>
<td>6</td>
<td>Yes</td>
<td>Energy Metering, Monitoring and Reporting: System level energy-metering with Meter 1</td>
<td>Provided</td>
<td>1</td>
<td>ME</td>
</tr>
<tr>
<td>ME</td>
<td>7</td>
<td>Yes</td>
<td>Energy Metering, Monitoring and Reporting: System level energy-metering with Meter 2</td>
<td>Provided</td>
<td>1</td>
<td>ME</td>
</tr>
<tr>
<td>ME</td>
<td>8</td>
<td>Yes</td>
<td>Energy Metering, Monitoring and Reporting: System level energy-metering with Meter 3</td>
<td>Provided</td>
<td>1</td>
<td>ME</td>
</tr>
<tr>
<td>ME</td>
<td>9</td>
<td>Yes</td>
<td>Energy Efficiency in Existing Buildings - Lighting Power Reduction</td>
<td>Provided</td>
<td>1</td>
<td>MB</td>
</tr>
<tr>
<td>ME</td>
<td>10</td>
<td>Yes</td>
<td>Energy Efficiency in Existing Buildings - High efficiency HVAC Equipment</td>
<td>Provided</td>
<td>1</td>
<td>ME</td>
</tr>
<tr>
<td>ME</td>
<td>11</td>
<td>Yes</td>
<td>Energy Efficiency in Existing Buildings - Daylight/Harvesting Controls</td>
<td>Provided</td>
<td>1</td>
<td>MB</td>
</tr>
<tr>
<td>ME</td>
<td>12</td>
<td>Yes</td>
<td>Energy Efficiency in Existing Buildings - Building-level metering</td>
<td>Provided</td>
<td>1</td>
<td>MB</td>
</tr>
<tr>
<td>ME</td>
<td>13</td>
<td>Yes</td>
<td>Renewable Energy - Provide Renewable Energy Credits (REC) equal to 10% of annual site electricity drawn through TVA or RECs equal to 35% from another source</td>
<td>Provided</td>
<td>1</td>
<td>CM</td>
</tr>
</tbody>
</table>

#### Points Credit Responsibility

<table>
<thead>
<tr>
<th>Programming</th>
<th>BD</th>
<th>DD</th>
<th>CD</th>
<th>Closeout</th>
<th>Checklist Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>12</td>
<td>62</td>
<td>30</td>
<td>12</td>
<td>62</td>
</tr>
</tbody>
</table>

#### Notes

- **ME** - Mechanical Engineer
- **WB** - Water Efficiency
- **CE** - Civil Engineer
- **CxA** - Commissioning Agent
- **CM** - Contractor
- **AB** - Architect
- **LA** - Landscape Architect

Print Date: 4/16/2021 12:37 PM

State of Tennessee HPBr 2/20/18 Page 2 of 4
### High Performance Building Requirements - 5/18/18

**CHECKLIST / TRACKING FORM**

<table>
<thead>
<tr>
<th>Checklist Total</th>
<th>Programming</th>
<th>BD</th>
<th>DD</th>
<th>CD</th>
<th>Closeout</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>12</td>
<td>32</td>
<td>12</td>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>17</td>
<td>2</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Closeout

1. **Possible Points**  19  
   **Credit ID**  19  
   **Applicable to Building/Site Scope?**  19  
   **Description**  19  
   **Level**  19  
   **Comments**  19  
   **Primary Credit Responsibility**  19  

### Possible Points  6

#### Innovation in Design and Construction

**Description**  6  
**Level**  6  
**Comment**  6  
**Primary Credit Responsibility**  6  

---

**Helpful Hints:**

1. Refrain from copying and pasting data in Column C. "Applicable to Building Scope?" as this can cause errors in some rows.
2. If any cell highlights red below, then you have a point allocated to a credit that is "not applicable." This is an error. Simply delete the contents of the cell to reset.
3. In Column C, if you have copied or pasted in this column and a cell highlights all red, delete the contents of that cell to correct the error.
4. If no points are available in the dropdown, this means you have listed that credit as "not applicable" and points cannot be attempted.

---

**Due to Limited renovation project scope, it will be very difficult to purchase 50% of Wood products harvested or manufactured in TN.**

**Due to the specific nature of the project program, it is not practical to use salvaged materials in this project.**

---

**Comment:** Describe implementation approach for each credit. New comments should be appended to old comments at each project phase. If credits are not further pursued or applicable, provide justification.

---

**Primary Credit Responsibility:**

<table>
<thead>
<tr>
<th>Role</th>
<th>O - Owner</th>
<th>C - Contractor</th>
<th>E - Electrical Engineer</th>
<th>M - Mechanical Engineer</th>
<th>CM - Commissioning Agent</th>
<th>CE - Civil Engineer</th>
<th>A - Architect</th>
<th>CM - Commissioning Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initials</td>
<td>CM</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

---

**Print Date:** 4/16/2021 12:37 PM

**State of Tennessee HPBr 2/20/18**

**Page 3 of 4**
### Checklist / Tracking Form

<table>
<thead>
<tr>
<th>Phase</th>
<th>Points Summary</th>
<th>Applicable</th>
<th>Minimum</th>
<th>Category from</th>
<th>Category</th>
<th>Compliance Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>Applicability Tree</td>
<td>C</td>
<td>Project Complies with the HPBr</td>
</tr>
<tr>
<td>SD</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DD</td>
<td>34</td>
<td></td>
<td>34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closeout</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Helpful Hints:

1. Refrain from copying and pasting data in Column C, “Applicable to Building/Site Scope?” as this can cause errors in some rows.
2. If any cell highlights red below, then you have a point allocated to a credit that is "not applicable." This is an error. Simply delete the contents of the cell to reset.
3. In column C, if you have copied or pasted in this column and a cell highlights all red, delete the contents of that cell to correct the error.
4. If no points are available in the dropdown, this means you have listed that credit as "not applicable" and points cannot be attempted.

#### Checklist Total:

<table>
<thead>
<tr>
<th>Programming</th>
<th>SD</th>
<th>DD</th>
<th>CD</th>
<th>Closeout</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>12</td>
<td>62</td>
<td>30</td>
<td>12</td>
</tr>
</tbody>
</table>

#### Checklist Total:

<table>
<thead>
<tr>
<th>Programming</th>
<th>SD</th>
<th>DD</th>
<th>CD</th>
<th>Closeout</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>12</td>
<td>62</td>
<td>30</td>
<td>12</td>
</tr>
</tbody>
</table>
# Land Management

<table>
<thead>
<tr>
<th># Points</th>
<th>Credit ID</th>
<th>Description</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>LM1.1</td>
<td>Site Selection - Reuse Existing Buildings</td>
<td>Priority 2</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM1.2</td>
<td>Site Selection - Show preference for building on developed sites; Preserve inland/wetland/habitat, wetlands, floodplains, public parkland</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM1.3</td>
<td>Site Selection - Brownfield Redevelopment - Remediate and Restore contaminated sites when possible</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM1.4</td>
<td>Site Selection - Urban Development - Locate building within existing infrastructure</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM2.1</td>
<td>Site Disturbance - Sediment and Erosion control during construction</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM2.2</td>
<td>Site Disturbance - Limit site disturbance during construction to minimum development footprint</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM3.1</td>
<td>Transportation - Plan for access to public transportation</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM3.2</td>
<td>Transportation - Provide bicycle storage for 5% of building occupants and showers/changing facilities for 0.5% of FTE occupants</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM3.3</td>
<td>Transportation - Plan site to include preferred parking for carpooling for 5% of all spaces provided</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM3.4</td>
<td>Transportation - Plan site to include preferred parking for low-emitting/fuel efficient vehicles for 5% of all spaces provided</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM4.1</td>
<td>Landscape Design - Maximize vegetated open space</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM4.2</td>
<td>Landscape Design - Native and drought tolerant planting</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM5.1</td>
<td>Heat Island Reduction - Non roof surface reflectivity and shading</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM5.2</td>
<td>Heat Island Reduction - Reflective roof materials</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM6.1</td>
<td>Stormwater Design - Post development discharge rate and volume not to exceed Pre-development rate</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM6.2</td>
<td>Stormwater Design - Reduce discharge rate and volume 25% on previously developed sites</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM6.3</td>
<td>Stormwater Design - Design to remove 80% Total Suspended solids from the average annual rainfall event. Verify local requirements.</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM6.4</td>
<td>Stormwater Design - Design per TDEC BMP References</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM7.1</td>
<td>Exterior Site Lighting - Design exterior lighting power to be 50% less than as allowed by ASHRAE 90.1-2010, Section 9.4.3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM7.2</td>
<td>Exterior Site Lighting - Locate fixtures to minimize illumination above the horizontal plane</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>LM7.3</td>
<td>Exterior Site Lighting - Locate exterior fixtures to minimize light trespass at property lines. Document foot-candle levels at site boundary</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

# Water Efficiency

<table>
<thead>
<tr>
<th># Points</th>
<th>Credit ID</th>
<th>Description</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>WE1.1</td>
<td>Water Efficient Landscaping, Utilize efficient irrigation technologies and planting measures</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>WE1.2</td>
<td>Water Efficient Landscaping, Non potable sources or no irrigation</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>WE2.1</td>
<td>Stormwater Treatment &amp; Conveyance: On site treatment</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Credit Verification Form

TN High Performance Building Requirements

In accordance with the State Architect’s office, a copy of this form must be submitted at the end of each project phase to the State Project Manager and accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form. The Checklist Workbook, and all worksheets within it, represents the HPBr compliance documentation for a project and must be maintained with the project records and submitted to the Office of the State Architect upon project close-out.

<table>
<thead>
<tr>
<th>HPBr Points Required</th>
<th>HPBr Points Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Points</th>
<th>Credit ID</th>
<th>Description</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>WE1.2</td>
<td>Wastewater Treatment &amp; Conveyance: Utilize non potable water</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>WE1.3</td>
<td>Water Use Reduction - Fixure flow and flush rates</td>
<td>Required</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>WE1.2</td>
<td>Water Use Reduction - Utilize auto-flow / auto-flush valves</td>
<td>Priority 2</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Points</th>
<th>Credit ID</th>
<th>Description</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>EE1.1</td>
<td>Commissioning - Basic commissioning process</td>
<td>Required</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE1.2</td>
<td>Commissioning - Advanced commissioning process</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE2.1</td>
<td>Energy Efficient Purchasing Policy - Energy Star qualified appliances &amp; equipment</td>
<td>Required</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE1.1</td>
<td>Energy Efficiency - Schematic Design energy modeling</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE3.2</td>
<td>Energy Efficiency - Life Cycle Cost Analysis</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE3.3</td>
<td>Minimum Energy Performance - all projects to demonstrate compliance with ASHRAE 90.1-2009, according to project scope</td>
<td>Required</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE3.4</td>
<td>Minimum Energy Performance - all projects to demonstrate compliance with ASHRAE 90.1-2010, according to project scope</td>
<td>Required</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE4.1</td>
<td>Energy Efficiency in Existing Buildings - Lighting Power Reduction</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE4.2</td>
<td>Energy Efficiency in Existing Buildings - Daylight Harvesting Controls</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE4.3</td>
<td>Energy Efficiency in Existing Buildings - Vacancy sensor-controlled lighting</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE4.4</td>
<td>Energy Efficiency in Existing Buildings - High efficiency HVAC Equipment</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE4.1</td>
<td>Energy Metering, Monitoring and Reporting: Building-Level Metering</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE4.2</td>
<td>Energy Metering, Monitoring and Reporting: System level energy metering with measurement and verification - New Construction</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE4.3</td>
<td>Energy Metering, Monitoring and Reporting: System level energy metering with measurement and verification - Existing Buildings</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE4.1</td>
<td>Long-Term Energy Reporting - Maintain energy and water consumption data in Energy Star Portfolio Manager</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE7.1</td>
<td>Renewable Energy - Investigate life-cycle cost effectiveness of on-site renewable energy</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>EE7.2</td>
<td>Renewable Energy - Provide Renewable Energy Credits (RECs) equal to 10% of annual site electricity through TVA or RECs equal to 35% from another source</td>
<td>Priority 2</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Points</th>
<th>Credit ID</th>
<th>Description</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>MR1.1</td>
<td>Recycling Collection and Storage</td>
<td>Required</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>MR2.1</td>
<td>Construction Waste Management (50%, 75%, 95%)</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>MR3.1</td>
<td>Sustainable Materials: Recycled content 10%</td>
<td>Required</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>MR3.2</td>
<td>Sustainable Materials: Recycled content 20%</td>
<td>Priority 2</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>MR3.3</td>
<td>Sustainable Materials: Tennessee Produced Materials (non-wood) - Harvested AND manufactured in state - 10% of total cost. Harvested OR manufactured in TN, 50% of</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>MR3.4</td>
<td>Sustainable Materials: Tennessee Produced Wood Products - Wood materials harvested AND manufactured in state - 50% of wood products. When harvested OR manufactured</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>MR3.5</td>
<td>Sustainable Materials: Regional materials - 20%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>MR3.6</td>
<td>Sustainable Materials: Material reuse</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>MR3.7</td>
<td>Sustainable Materials: Rapidly renewables</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Points</th>
<th>Credit ID</th>
<th>Description</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
</table>

Indoor Environmental Quality
# TN High Performance Building Requirements

In accordance with the State Architect's office, a copy of this form must be submitted at the end of each project phase to the State Project Manager and accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form. The Checklist Workbook, and all worksheets within it, represents the HPBr compliance documentation for a project and must be maintained with the project records and submitted to the Office of the State Architect upon project close-out.

<table>
<thead>
<tr>
<th># Points</th>
<th>Credit ID</th>
<th>Description</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ID1.1</td>
<td>Innovation in Design: Provide Specific Title</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>ID1.2</td>
<td>Innovation in Design: Provide Specific Title</td>
<td>Priority 2</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>ID1.3</td>
<td>Innovation in Design: Provide Specific Title</td>
<td>Priority 2</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>ID1.4</td>
<td>Innovation in Design: Provide Specific Title</td>
<td>Priority 2</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>ID2.1</td>
<td>Environmentally Accredited Design Team</td>
<td>Priority 1</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td><strong>Total HPBr Points Achieved by Project</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Materials and Resources Calculator

### TN HPBr Appendix B

### Instructions

Complete the table below with construction materials items, their associated costs, and percent by weight or volume of recycled content (pre and post-consumer).

### Materials Table

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>CONCRETE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MASONRY</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>METALS</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>WOOD, PLASTICS &amp; COMPOSITES</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>THERMAL / MOISTURE PROTECTION</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DOORS &amp; WINDOWS (OPENINGS)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FINISHES</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SPECIALTIES</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

### Points

- Percentage of Recycled Content (MR3.1 & MR3.2)
- Percentage of Regional Materials (MR3.5)
- Resource Reuse Percentage (MR3.6)
- Rapidly Renewable Materials Percentage (MR3.7)

<table>
<thead>
<tr>
<th>Points</th>
<th>Total $ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>0%</td>
<td>0</td>
</tr>
</tbody>
</table>

---

State of Tennessee HPBr 5/18/18

Page 1 of 1
PART 1 - GENERAL

1.01 REQUIREMENTS

Complete the processes of commissioning selected equipment and systems as specified. These should be listed in a companion section following this section. The absence of such a section does not negate the commissioning responsibilities. In the absence of such a section, review the specifications for commissioning requirements and provide a summary list as a submittal to the Designer for approval prior to performing the required commissioning.

1.02 SUBMITTALS

A. Functional Performance Testing: Prepare and submit to the Designer Functional Performance Testing Procedures for approval of equipment and systems. Contractor will use forms provided in this section of the specifications. Testing procedures will be detailed step-by-step and specific to each system. The approved procedures will be used to conduct the Functional Performance Testing. Functional Performance Testing will be completed prior to Substantial Completion.

B. Commissioning Data: Upon completion of the Functional Performance Testing, the Contractor will submit to the Designer the commissioning section of the Operation and Maintenance Binder. The binder will be divided into sections. The binder will contain copies of the manufacturer’s installation and start-up procedures utilized by the installer and/or contractor, completed Functional Performance Testing Procedures and associated forms from Sections 23 08 xx and 26 08 xx, signed Functional Performance Test Certificates, and equipment and maintenance records for equipment and systems operated prior to Owner acceptance.

1.03 ROLES:

A. Designer, using its Consultants will:

1. Review and approve the contractors Functional Performance Testing Procedures.

2. Report on field observations and report deficiencies to the contractor.

3. Observe the Contractor’s Functional Performance Testing.


5. Review final Commissioning Data.

B. Contractor:

1. Prepare and provide Functional Performance Testing Procedures for Designer approval.

2. Provide installation and start-up of all equipment and systems as prescribed by the manufacturer’s procedures.

3. Perform and maintain a maintenance and service log for equipment and systems that are being operated prior to Owner acceptance.

4. Provide manpower, supplies, testing instruments, etc. required to perform Functional Performance Testing.

6. Prepare three sets of Commissioning Data for Designer review and approval.

1.04 SYSTEMS TO BE COMMISSIONED:

A. The following mechanical systems and associated equipment are to be commissioned as specified. These include but are not limited to:
   1. Mechanical (HVAC) air and water
   2. Associated controls and building automation
   3. Domestic hot water

B. The following Electrical systems and associated equipment are to be commissioned as specified. These include but are not limited to:
   1. Electrical panel boards.
   2. Power circuits.
   3. Lighting levels.
   4. Generator and/or back-up power sources.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION

3.01 COMMISSIONING CONSTRUCTION PHASE:

Complete the following commissioning activities during the construction phase of the project. Submit for review and provide notification of activities.

A. Manufacturer’s system/equipment start-up procedures.

B. Specified manufacturer’s and/or independent testing agency reports.

C. Project schedule that included dates for start-up of equipment and systems, and Functional Performance Testing.

D. Minimum seven day notification of code required testing and specified cleaning of systems.

E. Minimum seven day notification of system and equipment start-up.

F. Control submittal on systems and equipment including drawings, sequences and programming.

G. Prepare detailed Functional Performance Testing Procedures for systems and equipment. Utilize the forms provided in this section of the specifications. Procedures will be detailed, step-by-step, and include description of expected results for verification. Modify test procedures as required by the Designers’ comments. Coordinate and schedule tests so that all parties involved will be present for final testing and acceptance.

H. Correct all deficiencies prior to final acceptance.
I. Prepare a list of all system and equipment warranties specified in the contract documents. Provide the warranty item and the contract document section number. Provide the Designer with an update list throughout the project.

J. Prepare a list of all deliverables specified in the contract documents. Provide the deliverable item and the contract document section number. Provide the Designer with an updated list throughout the project.

K. Prepare a list of all Training and Demonstrations specified in the contract documents. Provide the type of Training and/or Demonstration and the contract document section number. Provide the Designer with an updated list throughout the project.

L. Prepare a list of all tests, reports, services, etc. whether required by codes, independent authorities, or manufacturers as specified in the contract documents. Provide the type of test, report, services, etc. and the contract document section number. In the case that the test is required by state or local codes, update the list as soon as the information is available. Provide the Designer with an updated list throughout the project.

M. Systems and/or equipment will not be used for temporary purposes of any kind until authorized by the Designer in writing to ensure that required maintenance and warranties remain in force. The Contractor will be responsible for maintenance of all systems and equipment until final acceptance and will maintain on site a binder containing schedules of maintenance activities, items checked, repairs or replacements made and documents to verify that the work was performed. The documentation contained in this binder will become part of the commissioning binder.

3.02 COMMISSIONING ACCEPTANCE PHASE:

Complete the following commissioning activities during the acceptance phase of the project. The activities described in this section must be completed prior to Substantial Completion.

A. Perform Functional Performance Tests of mechanical and electrical systems and equipment as specified utilizing the testing procedure prepared by the Contractor and approved by the Designer to verify proper calibration, operation and performance. The Contractor is responsible for providing all manpower, equipment and/or testing instruments required to perform tests. Functional Performance Testing will be performed in the presence of the Designer/Consultant and the Owner. Tests that fail to perform as required will be retested upon correction. If retesting has to be rescheduled, the Contractor will be responsible for any additional charges.

B. All deliverables prescribed in the contract documents will be delivered to the Owner at the location designated by the Owner.

C. Perform all training and demonstrations prescribed in the contract documents.

D. Provide three final commissioning binders to the Designer for review and approval. Ensure that all forms are completely filled out and all testing results documented. If missing or incomplete information and/or data is identified by the Designer, reassemble replacement manuals with complete information prior to project final payment.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
<table>
<thead>
<tr>
<th>Piece of Equipment</th>
<th>Tag Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Step by Step Detailed Procedure</td>
<td>Expected Result</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Project Name: VA Campus Building 2 First Floor Renovation
SBC Number: 369/005-06-2020
Identification of Equipment or System: <<Identification information>>
Location of Equipment or System: <<Location information>>
Manufacturer /Supplier: <<Manufacturer / supplier information>>
This Date: <<Date>>
Functional Performance Test Procedure Number: <<Number>>
Components Included: <<Components information>>

The above systems and components integral to this equipment are complete and have undergone functional performance tests. All functional performance test procedures are complete and have been checked off only by parties having direct knowledge of the event, as indicted below, respective to each responsible contractor. This functional performance test is submitted for approval and is subject to the attached list of outstanding items not completed successfully. Contractor shall submit a deficiency form upon completion of any outstanding or deficient items. None of the outstanding items preclude safe and reliable functional tests being performed.

Check One: ☐ Deficiency listing attached; or, ☐ No deficiencies found.

All Designer and Contractor punch list items for this system and related equipment have been addressed and corrected prior to functional performance testing.

The functional performance test procedures were reviewed and approved by the installer and applicable subcontractors prior to testing.

CONTRACTOR'S CERTIFICATION OF PERFORMANCE:

I hereby certify that the above described equipment or system, has been energized, operated, adjusted, and balanced in accordance with requirements of the Contract Documents and the manufacturer's recommendations for a sufficient period to confirm that operation complies in all respects with the contract requirements.

<table>
<thead>
<tr>
<th>Signature</th>
<th>Printed Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installer:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>General Contractor:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>Designer / Consultant:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 02 41 19 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 003126 Asbestos Survey Information Available to Bidders
2. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
3. Section 01 32 33 "Photographic Documentation"
4. Section 01 73 00 "Execution" for cutting and patching procedures.
5. Section 017419 Construction Waste Management and Disposal
6. Section 018114 High Performance Building Requirements (HPBr)

1.3 DEFINITION

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.
E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove items they wish to salvage.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.
1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

   1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

   1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.
3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
   a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
   c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
   f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide weathertight temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
SELECTIVE DEMOLITION

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area on-site.

5. Protect items from damage during transport and storage.
D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCl's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.
3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19
Asbestos Abatement Specification
Veterans Administration Medical Center
Building 2, First Floor Renovations
Mountain Home, Tennessee
S&ME Project No. 211350

PREPARED FOR:
Clark Nexsen, Inc.
301 College Street, Suite 300
Asheville, North Carolina 28801

PREPARED BY:
S&ME, Inc.
644 Eastern Star Road
Kingsport, TN 37663

April 21, 2021
April 21, 2021

Clark Nexsen, Inc.
301 College Street, Suite 300
Asheville, North Carolina 28801

Attention: Mr. Aaron Brumo

Reference: Asbestos Abatement Specification
VAMC Building 2, First Floor Renovation
Mountain Home, Tennessee
S&ME Project No. 211350

Dear Mr. Brumo:

S&ME, Inc. (S&ME) is pleased to provide the enclosed asbestos abatement specification for the referenced location. Our services were provided in general accordance with S&ME Proposal No. 211350, and Change Order No. 1 dated March 31, 2021, as authorized by return of our change order. The specification is based upon the hazardous materials assessment conducted by S&ME and reported as S&ME Project Number 211350 dated March 26, 2021 as authorized by return of our signed contract.

This specification is provided for the sole use of Clark Nexsen, Inc., East Tennessee State University and the asbestos abatement contractor performing the work. Use of this report by any other parties will be at such party's sole risk and S&ME disclaims liability for any such use or reliance by third parties. The results presented in this report are indicative of conditions only during the time of the assessment and of the specific areas referenced.

S&ME appreciates this opportunity to provide our services to you. Please call if you have questions concerning this technical specification at 423-349-2817.

Sincerely,

S&ME, Inc.

Carol Goldinger Ford
Senior Project Manager

Emily Mollish
Asbestos Project Designer
A-PD-68828-82465

Senior Review by James R. Bruce
# Table of Contents

1. Background ........................................................................................................................ 1

2. Standards ............................................................................................................................ 1
   2.1. Summary ................................................................................................................................. 1
   2.2. Codes and Regulations ............................................................................................................ 1
   2.3. Standards ................................................................................................................................. 4
   2.4. Notices and Permits ....................................................................................................................... 5
      2.4.1. State and Local Agencies ........................................................................................................... 5
      2.4.2. Licenses and Accreditations ....................................................................................................... 5
      2.4.3. Posting and Filing of Regulations ............................................................................................. 5

3. Scope of Work .................................................................................................................... 5

4. Personal Protective Equipment ...................................................................................... 6

5. Containment Protocol for Friable ACM Removal ...................................................... 7

6. Work Area Preparation (Glove Bag Removal) ............................................................ 8

7. Decontamination Units and Loadouts ........................................................................ 8

8. Security ................................................................................................................................ 9

9. Work Practices ................................................................................................................... 9

10. Waste ................................................................................................................................ 11

11. Project Monitoring .......................................................................................................... 11

12. Clearance ........................................................................................................................... 12

13. Personal Samples ............................................................................................................ 12

14. Submittals .......................................................................................................................... 12

15. General .............................................................................................................................. 13

## Appendices

Appendix I – Figure
1. Background

1.1. The work described in this asbestos abatement specification is based upon information obtained and reported by S&ME, Inc. (S&ME) as S&ME Project Number 211350 dated March 26, 2021.

1.2. This work has been conducted in general accordance with S&ME Change to Agreement CO 1 for Consulting Services dated March 31, 2021.

1.3. Only Clark Nexsen, Inc., East Tennessee State University, and the asbestos abatement contractor chosen to perform this work may rely upon this document.

1.4. This document applies to the abatement of asbestos-containing material (ACM) as described in Section 3 and on Figure 1, Approximate Location of Identified Asbestos-containing Materials developed from a drawing dated July 22, 2019 from Clark Nexsen, Inc. (Appendix I) for the VAMC Building 2, First Floor Renovation.

1.5. Those specified in this section may rely upon this work for the specific project for which it was prepared. S&ME disclaims any liability for reliance on this work by others, or for any other project.

1.6. Work associated with this project is subject to the terms and conditions of the proposal specified in paragraph 1.2 of this document.

2. Standards

2.1. Summary

2.1.1. This Section (Section 2 Standards) sets forth governmental regulations and industry standards, which are included and incorporated herein by reference and made a part of this specification. This Section also sets forth those notices and permits that are known to the Owner and which either must be applied for and received, or that must be given to governmental agencies before start of work.

2.1.2. Requirements include adherence to work practices and procedures set forth in applicable codes, regulations, and standards.

2.1.3. Requirements include obtaining permits, licenses, inspection, releases and similar documentation, as well as payments, statements, and similar requirements associated with codes, regulations, and standards.

2.2. Codes and Regulations

2.2.1. General Applicability of Codes and Regulations, and Standards: Except to the extent that more explicit and more stringent requirements are written directly into the Contract documents, all applicable codes, regulations, and standards have the same force and effect (and are made a part of the Contract documents by reference) as if copied directly into the Contract documents, or as if published copies are bound herewith.

2.2.2. Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all applicable federal, state, and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable federal, state, and local regulations. The Contractor shall hold the Owner and S&ME harmless for failure to comply with...
any applicable work, hauling, disposal, safety, health, or other regulation on the part of themselves, their employees, or their subcontractors.

2.2.3. **Federal Requirements**: Which govern asbestos abatement work, or hauling and disposal of asbestos waste materials include but are not limited to the following:

2.2.3.1. **OSHA**: U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA), including but not limited to:

   - Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules
     Part 1926, Section 1101 of the Code of Federal Regulations

   - Respiratory Protection
     Title 29, Part 1910, Section 134 of the Code of Federal Regulations

   - Construction Industry
     Title 29, Part 1926, of the Code of Federal Regulations

   - Access to Employee Exposure and Medical Records
     Title 29, Part 1910, Section 2 of the Code of Federal Regulations

   - Hazard Communication
     Title 29, Part 1910, Section 1200 of the Code of Federal Regulations

   - Specification for Accident Prevention Signs and Tags
     Title 29, Part 1910, Section 145 of the Code of Federal Regulations

2.2.3.2. **DOT**: U.S. Department of Transportation, including but not limited to:

   - Hazardous Substances
     Title 29, Part 171 and 172 of the Code of Federal Regulations
2.2.3.3. **EPA:** U. S. Environmental Protection Agency (EPA), including but not limited to:

- Requirements of the Asbestos Hazard Emergency Response Act (AHERA)
- Asbestos-Containing Materials in Schools Final Rule & Notice
- Title 40, Part 763, Sub-part E, Appendix C of the Code of Federal Regulations

- National Emission Standard for Hazardous Air Pollutants (NESHAP)
- National Emission Standard for Asbestos
  - Title 40, Part 61, Sub-part A, and Sub-part M
  - (Revised Sub-part B) of the Code of Federal Regulations


2.2.3.4. **Tennessee:**

- TN – Division of Air Pollution Control – Rule 1200-03-11-.01 & .02, "Hazardous Air Contaminants – Asbestos"


- Rules of the Department of Environment and Conservation – Chapter 1200-01-20 et. seq., Asbestos Accreditation Requirements


- Tennessee Occupational Safety and Health Act of 1972, TCA 50-3-101 through 50-3-919.

- Rules of Tennessee Department of Labor and Workforce Development, Division of Occupational Safety and Health, Chapter 0800-01-06 et. seq., Occupational Safety and Health Standards for Construction.

- Rules of Tennessee Department of Labor and Workforce Development, Division of Occupational Safety and Health, Chapter 0800-01-01 et. seq., Occupational Safety and Health Standards for General Industry.

- Rules of Tennessee Department of Labor and Workforce Development, Division of Occupational Safety and Health, Chapter 0800-01-3 et. seq., Occupational Safety and Health Record-Keeping and Reporting.
2.2.3.5. **Local Requirements:** Abide by all local rules, regulations, ordinances, etc. which govern the specified asbestos abatement work, licensing, permitting, building code, fire protection requirements, or hauling and disposal of asbestos waste removal.

2.3. **Standards**

2.3.1. **General Applicability of Standards:** Except to the extent that more explicit or more stringent requirements are written directly into the Contract documents, all applicable standards have the same force and effect and are made a part of the Contract documents by reference as if copied directly into the Contract, or as if published copies are bound herewith.

2.3.2. **Contractor Responsibility:** The Contractor shall assume full responsibility and liability for the compliance with all standards pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor shall hold the Owner and S&ME harmless for failure to comply with any applicable standard on the part of himself, his employees, or his subcontractors.

2.3.3. **Standards:** Which apply to asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

- **American National Standards Institute (ANSI)**
  1430 Broadway
  New York, NY  10018
  212/354-3300

  Practices for Respiratory Protection Publication Z88.2-80
  "American National Standard for Respiratory Protection
  -Respiratory Use - Physical Qualifications for Personnel,"
  Z88.6-1984.

- **American Society for Testing and Materials (ASTM)**
  1916 Race Street
  Philadelphia, PA  19103
  215/299-5400

  Safety and Health Requirements Relating to Occupational Exposure to Asbestos
  E 849-82

  Specification for Encapsulants for Friable Asbestos-Containing Building Materials
  Proposal P-189
2.4. Notices and Permits

2.4.1. State and Local Agencies
Send written notification with all required information within the mandated time period prior to commencement of asbestos removal operations to:

State of Tennessee
Department of Environment and Conservation
Division of Air Pollution Control
Nashville Environmental Field Office
711 R.S. Gass Boulevard
Nashville, Tennessee 37216

Obtain and post on site a copy of the notification to perform asbestos operations. Submit amendments and have the permit revised as needed to comply with regulations to the property owner and/or S&ME upon completion of the job.

2.4.2. Licenses and Accreditations
Licenses and Accreditations: Maintain current licenses and accreditations as required by applicable state or local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the work of this Contract.

2.4.3. Posting and Filing of Regulations
Posting and Filing of Regulations: Post all notices required by applicable federal, state, and local regulations at the job site during the work. Maintain two (2) copies of applicable federal, state and local regulations and standard. Maintain one copy of each at job site. Keep on file in Contractor’s office one copy of each.

3. Scope of Work

3.1. Removal of asbestos-containing thermal system insulation (TSI) identified within cavities of the original brick walls of Building 2, first floor, primarily on plumbing lines as observed in Bathroom 107A. The exact location and quantity are unknown, but the materials are potentially located on other piping systems throughout brick wall cavities in Building 2, first floor. Figure 1, Approximate Location of Identified Asbestos-containing Materials, developed from a figure provided by Clark Nexen, Inc. dated July 22, 2019 (included in Appendix I) highlights the potential locations of asbestos-containing TSI.

3.2. The following ACMs outlined in Table 3-1 below were identified and will be impacted by the renovation activities.
### Table 3-1 Identified Asbestos-containing Materials

<table>
<thead>
<tr>
<th>HA</th>
<th>Material Description</th>
<th>¹Sample Location</th>
<th>²Quantity</th>
<th>³Type</th>
<th>⁴Cond / PD</th>
<th>Category</th>
<th>Asbestos Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Fibrous Pipe Joint Insulation w/ Gray Coating</td>
<td>Potentially hidden in the brick walls throughout the building; visible in Bathroom 107A</td>
<td>~5 LF Visible</td>
<td>TSI</td>
<td>Poor/ High</td>
<td>Friable</td>
<td>40% Chrysotile</td>
</tr>
<tr>
<td>26</td>
<td>Papered Layered Pipe Insulation w/ black felt</td>
<td>Potentially hidden in the brick walls throughout the building; visible in Bathroom 107A</td>
<td>~5 LF Visible</td>
<td>TSI</td>
<td>Poor/ High</td>
<td>Friable</td>
<td>40% Chrysotile</td>
</tr>
<tr>
<td>27</td>
<td>Paper pipe insulation w/ cloth and white fibrous material</td>
<td>Potentially hidden in the brick walls throughout the building; visible in Bathroom 107A</td>
<td>~5 LF Visible</td>
<td>TSI</td>
<td>Poor/ High</td>
<td>Friable</td>
<td>20% Chrysotile</td>
</tr>
</tbody>
</table>

HA = Homogeneous Area       SF = Square feet      LF = Linear feet              CF = Cubic Feet

¹Refer to March 26, 2021 Hazardous Materials Assessment VAMC Building 2 (Ed Allen Hall) First Floor Renovation Report prepared by S&ME, Inc. Project No. 211350. A copy of this report can be obtained at Clark Nexen, Inc. office or ETSU’s Construction office.

²Quantities are approximate and should not be used for cost estimates or bidding purposes.

³Type: Misc. = Miscellaneous     Sur = Surfacing       TSI = Thermal System Insulation

⁴Cond = Condition: Good, Fair or Poor

PD = Accessible during renovation or demolition with Potential for Disturbance; Low or High

3.3. The contractor shall field verify all quantities prior to starting abatement work or fulfilling reporting requirements. There will be no allowance/additions made for varying quantities of work unless that work is not in a specified area. (Unless the owner overrides this provision by making other arrangements in the contract such as per linear foot of TSI.)

3.4. Any required permits shall be obtained by the contractor at no additional cost to the owner.

### 4. Personal Protective Equipment

4.1. During asbestos abatement, disposable coveralls, including head covers and shoe covers shall be worn at all times.

4.2. Appropriate respiratory protection shall be used whenever workers enter work area.

4.3. Respirators shall not be left exposed when not in use; they shall be properly stored.

4.4. Used respirator filters and disposable coveralls shall be disposed of as ACM.
5. Containment Protocol for Friable ACM Removal

5.1. A critical containment for control of dust shall be erected prior to any disturbance of friable ACM or non-friable ACM that is to be removed as friable. All movable objects should be removed from the work area before the containment is constructed unless moving the objects creates a hazard. If moving mobile objects creates a hazard, these items that remain in the work area will be assumed to be contaminated and shall either be cleaned with amended water and a high-efficiency particulate air (HEPA) vacuum and removed from the area or wrapped and disposed of as hazardous waste.

5.2. Stationary objects within the containment shall be cleaned prior to abatement and covered with two layers of 6-mil polyethylene plastic sheeting. The sheeting shall be secured with duct tape or equivalent method to provide an air and waterproof seal around the object.

5.3. All openings into the work area shall be covered with critical barriers. A critical barrier consists of two layers of 6-mil polyethylene plastic sheeting sealed over all openings into a work area or any other similarly placed physical, impermeable barrier sufficient to prevent airborne asbestos in a work area from migrating to an adjacent area. The second layer shall overlap the first layer by at least 2 inches.

5.4. Individually seal all ventilation openings (supply and exhaust), windows, doorways, convectors, and other openings into the work area with a rigid impermeable structure, duct tape alone, or with 6-mil polyethylene sheeting taped securely in place with duct tape. Maintain seal until all work including final clearance air testing and project decontamination is completed. If sealing off lighting fixtures, take care to avoid melting or burning of plastic sheeting.

5.5. Disable any system bringing air into or out of the work area. Disable system by disconnecting wires, removing circuit breakers, with lockable switches, or other positive means that will prevent accidental, premature restarting of equipment.

5.6. Containments shall be smoke tested and inspected by the Contractor at least daily and the results recorded by the contractor’s supervisor.

5.7. A three-stage decontamination unit and load out shall be attached to the containment. Waste shall remain adequately wet and be immediately bagged for disposal. Waste material shall be double-bagged and sealed in clear plastic bags designed for asbestos disposal, and labeled with appropriate generator and transporter labels. Filters removed from the negative air machines used inside the containment shall be handled as asbestos waste. Waste material with sharp points or corners must be placed in hard, impermeable, air-tight containers. Large components should be sealed in two layers of 6-mil polyethylene plastic sheeting and removed intact.

5.8. The containment shall be maintained under negative pressure for the duration of the work through successful final clearance testing. Fresh outdoor air is to be drawn into the containment under all anticipated conditions and exhausted through a HEPA filter for 24 hours a day during the entire duration of the project.

5.9. A recording manometer will be used to measure negative pressure in the containment. The probe shall be placed more than 5 feet from the nearest HEPA Exhaust unit. Manometers shall be calibrated by the Contractor prior to the start of each work shift.

5.10. Negative pressure shall be maintained at -0.02 inches of water (-0.02” of H₂O). Air pressure shall be continuously monitored with alarms set at -0.02” H₂O.

5.11. Manometer readings shall be included in closeout documentation given to the property owner. If the manometer demonstrates a reduction in pressure differential below the required level, work should cease and the reason for the change investigated and appropriate changes made.
5.12. The air flow exhausted from the workplace must exceed the amount of makeup air supplied to the containment. The volume of air flow removed from the containment should replace the volume of the containment at least four times per hour. All exhausts shall be ducted to the outside of the building into an unoccupied area. Do not vent at street level.

6. **Work Area Preparation (Glove Bag Removal)**

6.1. Establishing the Work Area: Where practical, the work area will extend from the piping to be glove bagged to the nearest physical barriers (walls, floors, and/or HVAC units).

6.2. Prior to removal, HEPA filter vacuum any debris in the immediate vicinity of the removal area. Place polyethylene plastic drop cloths beneath the glove bags.

6.3. Install glove bag according to manufacturer’s recommendations, and in accordance with 29 CFR 1926.1101.

6.4. All building ventilation air systems connected to the work area shall be turned off and sealed with critical barriers during preparation.

6.5. The Contractor shall establish and mark emergency and fire exits from the work area. Emergency procedures shall have priority over established decontamination entry and exit procedures. Audible and visible fire and emergency evacuation alarms shall be installed so as to be heard and seen throughout the entire work area. Install portable fire extinguishers in compliance with National Fire Protection Association, standard No. 10 portable extinguishers. A minimum of (1) ABC dry chemical rated (minimum 20 lbs) fire extinguisher shall be in the clean room plus one for every 3000 square feet in the work area.

6.6. Glove bags shall be smoke tested and inspected by the Contractor prior to use and at least daily and the results recorded by the contractor’s onsite Supervisor.

6.7. The Contractor shall implement an electrical practice protocol that includes, but is not limited to, lockout and ground fault circuit interrupter (GFCI) shutdown as described in OSHA Construction Standard 29 CFR 1926.417. All electrical powered equipment utilized during the project shall have ground-fault protection as described in OSHA Construction Standards 29 CFR 1926.404 (b). All equipment and wiring shall be in compliance with National Fire Protection Association Standard 70, and the National Electrical Code. The Owner’s maintenance personnel shall connect the Contractor’s power source to the Owner’s facility.

6.8. Elevators used to transport waste shall have a 6-mil polyethylene plastic barrier covering the walls, ceiling, and floor. A 6-mil secondary barrier shall be used to cover the floor. It shall be HEPA vacuumed or wet wiped and removed at the end of each shift. Asbestos waste must be transported from the work area to the dumpster or truck in a closed cart or other rigid, closed container. These containers shall be lined with 6-mil polyethylene plastic.

7. **Decontamination Units and Loadouts**

7.1. Decontamination units shall consist of a connected arrangement of compartments.

7.2. These shall be clean room, shower room, and equipment room.

7.3. Doors shall be of the 3-layer, Z-flap design.

7.4. Loadouts shall consist of three compartments separated by 3-layer, Z-flap doors.

7.5. Waste shall be carried into the equipment room by fully protected workers, bagged a second time and cleaned off with water prior to transporting through the clean room.
8. Security

8.1. While asbestos abatement work is being performed, at least one worker shall remain outside the regulated area. This person shall maintain security against unauthorized access to the asbestos abatement area.

8.2. Whenever an asbestos abatement area has not been cleared but is left unattended, access to the site shall be denied to unauthorized personnel by the use of locked doors or other similar means of securing the area. The Contractor shall construct "hard" barriers as necessary to restrict entry.

8.3. Waste containers shall be secured and locked within a fence or sufficient to maintain security of the material or other secure enclosure, or the waste container itself shall be closed and locked when not under observation. Unsecured open top or similar dumpsters/waste containers are not permitted.

9. Work Practices

9.1. General

9.1.1. Sequence of Work

9.1.1.1. Build and have decontamination process operational before any workers enter work area to disturb ACM.

9.1.1.2. Waste container shall be onsite prior to the start of asbestos abatement. No abatement shall be permitted without a waste container onsite.

9.1.1.3. S&ME will inspect and accept the work area prior to start of asbestos removal. A 24-hour notice shall be given for inspection of the work area prior to the start of asbestos removal.

9.1.1.4. Wet methods and HEPA-vacuuming shall be used to control generation of dust.

9.1.2. The waste bags and containers shall be marked with the OSHA label prescribed by the OSHA 29 CFR 1926.1101 standard referenced in these specifications. In addition to the OSHA labeling requirements, all containers shall be labeled with the name of the waste generator and the location at which the waste was generated during the load out sequence, and before loading the asbestos waste into a container/vehicle prior to transporting off the facility property.

9.1.3. All excess water (except shower water) shall be either combined with removed material or other absorptive material and properly disposed of per EPA regulations, or filtered, using a 5-micron final filter and disposed in the sanitary sewage system. Contractor shall not place water in storm drains, onto lawns, or into ditches, creeks, streams, rivers or other areas.

9.2. Glove Bags

9.2.1. The Contractor shall not remove asbestos from any hot water or steam lines until they have ensured that the temperature of the line does not exceed 130°F.

9.2.2. The Contractor shall not conduct asbestos removal from any live steam line.

9.2.3. The Owner shall be responsible for maintaining the piping at or below 130°F until the Contractor completes the project and for shutting down and purging all live steam lines before the Contractor arrives to begin preparation. The Owner shall provide written notice to the Contractor, Designer and State Construction Office when these tasks have been accomplished.

9.2.4. Prior to asbestos removal, the Contractor’s equipment, work area and decontamination units will be inspected and approved by the Project Monitor and/or Asbestos Project Designer.

9.2.5. A team (or teams) having a minimum of two persons is required to perform glove bag removal. One person shall perform the removal using the glove bag. The other person shall be present at all times to assist, as required.
9.2.6. Glove bags are for single use and will not be reused or repositioned.

9.2.7. Prior to hanging the glove bag on badly damaged or deteriorated sections of piping, encapsulate the insulation with at least one coat of penetrating encapsulant to prevent the release of fibers during installation of the glove bag.

9.2.8. Slit top of the glove bag open (if necessary) and cut down the sides to accommodate the size of the pipe (about 2 inches longer than the pipe diameter).

9.2.9. Place necessary tools into pouch located inside glove bag. This will usually include: bone saw, utility knife, rags, non-metallic scrub brush, wire cutters, tin snips and pre-wetted cloth.

9.2.9.1. Place one strip of duct tape along the edge of the open top slit of glove bag and another along the bottom seam for reinforcement.

9.2.10. Place the glove bag around section of pipe to be worked on. Use reinforcing duct tape to seal section. Next, duct tape the ends of glove bag to pipe itself, where previously covered with plastic or duct tape.

9.2.11. The Contractor shall use a smoke tube and aspirator bulb to test seal on all glove bags as follows:

9.2.11.1. Place tube into water sleeve (2-inch opening to glove bag) squeezing bulb and filling bag with visible smoke.

9.2.11.2. Remove smoke tube and twist water sleeve closed.

9.2.11.3. While holding the water sleeve tightly, gently squeeze glove bag and look for smoke leaking out, (especially at the top and ends of the glove bag).

9.2.11.4. If leaks are found, tape closed using duct tape and retest.

9.2.12. Insert wand from garden sprayer through water sleeve. Duct tape water sleeve tightly around the wand to prevent leakage.

9.2.13. One person places their hands into the long-sleeved gloves while the second person directs garden sprayer at the work.

9.2.14. Use bone saw, if required, to cut insulation at each end of the section to be removed. Throughout this process, spray amended water or removal encapsulant on the cutting area to keep dust to a minimum.

9.2.15. Remove insulation using putty knives or other tools. Place small pieces in bottom of bag without dropping.

9.2.16. Rinse all tools with water inside the bag and place back into pouch.

9.2.17. Using scrub brush, rags and water, scrub and wipe down the exposed pipe.

9.2.18. Remove water wand from water sleeve and attach the small nozzle from HEPA filtered vacuum. Turn on the HEPA vacuum only briefly to collapse the bag.

9.2.19. Remove the HEPA vacuum nozzle, twist water sleeve closed and seal with duct tape.

9.2.20. Put the tools into a sleeve of the glove bag, turning the sleeve inside out and twist the sleeve tightly. Place duct tape over twisted portion and then cut the tool bag from the glove bag, cutting through the twisted/taped section. Contaminated tools may then be placed directly into next glove bag without cleaning. Alternatively, tool pouch with the tools can be placed in a bucket of water, opened underwater, and tools cleaned and dried. Discard rags and scrub brush with asbestos waste.

9.2.21. With removed insulation in the bottom of the bag, twist the bag several times and tape the opening at the top to keep the material in the bottom of the bag during removal of the glove bag from the pipe.
9.2.22. Remove glove bag and place into 6-mil clear polyethylene disposal bag. Collapse the bag with a HEPA vacuum, twist top of bag, seal with at least three wraps of duct tape, bend over and seal again with at least three wraps of duct tape. Dispose as required by this specification.

9.2.23. Clean all surfaces in the work area using disposable cloths wetted with water with surfactant or removal encapsulant added. When these surfaces have dried, clean with a HEPA filtered vacuum. Material adhered to a surface with removal encapsulant may require the application of additional removal encapsulant to facilitate cleaning.

9.2.24. Any asbestos-containing insulation edges that have been exposed during the removal must be encapsulated with a bridging encapsulant or sealed with 6-mil polyethylene and duct tape to ensure that there is no release of fibers from the edges.

9.2.25. All polyethylene sheeting, tape, cleaning material, clothing, and all other disposable material or items used in the work area shall be packed into sealable polyethylene bags (6-mil minimum). Each bag shall be individually sealed.

9.2.26. All material shall be double-bagged and the outside bag and container shall be clean before leaving the work area. The bags and containers shall be marked with the OSHA label prescribed by the OSHA 29 CFR 1926.1101 standard referenced in these specifications. In addition to the OSHA labeling requirements, all containers shall be labeled with the name of the waste generator and the location at which the waste was generated during the load out sequence and before loading the asbestos waste into a container/vehicle prior to transporting off the facility property.

9.2.27. All excess water shall be combined with removed material or other absorptive material and properly disposed of as per EPA regulations, or filtered using a 5 micron final filter and disposed in the sanitary sewage system. Contractor shall not place water in storm drains, onto lawns, or into ditches, creeks, streams, rivers or other areas.

10. Waste

10.1. All asbestos-containing waste shall be double-bagged.
10.1.1. Bags shall be clear and of 6-mil polyethylene.
10.1.2. Bags shall have the required EPA generator, Department of Transportation (DOT), and OSHA labels.

10.2. Waste water, including shower water and any other water leaving the regulated area in a liquid state, shall be filtered through a minimum 5-micron filter. The filtered water may be disposed into the sanitary sewer, unless local regulation prohibits that method of disposal.

10.3. Temporary waste storage on site shall be lined with 6-mil polyethylene and locked when not loading. Open top dumpsters are not acceptable.

10.4. Waste shall be disposed of in a properly permitted landfill.

10.5. The Owner’s copy of the fully executed waste manifest shall be submitted with post-job submittals within 14 days after the end of the work. The end of the work is the end date on the asbestos abatement permit.

11. Project Monitoring

11.1. The Owner shall provide for on-site monitoring during abatement.
11.2. A Project Monitor shall collect area air sampling for asbestos, as deemed advisable. Typically they will be collected as follows:
11.2.1. at least one air sample inside the contained area,
11.2.2. at least one air sample at the HEPA exhaust but not in the direct air flow,
11.2.3. at least one air sample at the clean room, and
11.2.4. at least two samples outside the work area, preferably near occupied areas and/or areas accessible to the public.

11.3. The Project Monitor shall check the manometer readings at least four times per 8-hour shift (five times for a 10-hour shift and six times for a 12-hour shift). They shall record the manometer reading in the field notes and on a chart to remain at the jobsite for review by the contractor, owner, regulators, and other authorized parties.

11.4. The Contractor will cooperate with the Project Monitor, and should unsafe conditions be identified by the Project Monitor, appropriate corrective actions, including stopping work, shall be instituted.

11.5. The Project Monitor will not supervise the remediation work.

11.6. The Contractor shall be responsible for unsafe conditions that arise out of the work.

11.7. The on-site Project Monitor is not responsible for collection of OSHA-required personal samples for the Contractor.

12. Clearance

12.1. A firm with a valid asbestos firm license and staff who are Tennessee-licensed Asbestos Project Monitors will conduct a final visual inspection and Phase Contrast Microscopy (PCM) clearance monitoring for all interior asbestos abatement work on behalf of the Owner.

12.2. No clearance inspection or monitoring shall be conducted until all asbestos abatement inside a regulated area is complete and passes a visual inspection.

12.3. Five (5) 1200-liter or more air samples will be collected for each PCM clearance within the regulated area. Clearance criteria is all samples <0.01 fibers per cubic centimeter (f/cc). Volume requirements and number of samples per clearance may be adjusted with approval of the Project Monitor.

12.4. The Contractor may not remove critical barriers or HEPA filtered ventilation until the work area is cleared.

13. Personal Samples

13.1. The Contractor shall collect and analyze personal samples as required by OSHA.

13.2. The results of personal sampling shall be posted at the job site within two days of receipt of results.

13.3. A copy of all personal sample results shall be included in the post-job submittal package.

14. Submittals

14.1. One copy of pre-job submittals shall be submitted to Clark Nexsen, Inc. and/or ETSU for review at least one week prior to start of abatement work. Pre-job submittals shall include:

14.1.1. A directory of contacts, including at least the Contractor’s Corporate Office phone number, the project superintendent’s office and cellular numbers, and the project site foreman’s office and cellular numbers.


14.1.3. A copy of each person’s current accreditations and State of Tennessee accreditation card.

14.1.4. A copy of each person’s current medical authorization to work with asbestos and wear a respirator.
14.1.5. A copy of the Contractor’s respiratory protection program, including the rationale and documentation for respirator selection on this job. This document shall meet the requirements of 29 CFR 1910.134.

14.1.6. A copy of the State of Tennessee Notification of Demolition and/or Asbestos Renovation permit CN-1055.

14.2. On-site documentation shall include:
   14.2.1. Properly completed State permit.
   14.2.2. A roster of workers and supervisors.
   14.2.3. A copy of each person’s current accreditations.
   14.2.4. A copy of each person’s current medical authorization to work with asbestos and wear a respirator.
   14.2.5. A copy of the Contractor’s respiratory protection program, including the rationale and documentation for respirator selection on this job.
   14.2.6. A copy of the Contractor’s hazard communication program, including:
      14.2.6.1. Safety Data Sheets for asbestos and all chemicals used on site.
      14.2.6.2. An inventory of chemicals on site.

14.3. Post-job submittals shall be submitted within 30 days of asbestos abatement completion (as shown on the latest revision of the permits) and shall include:
   14.3.1. Any additions or changes to the pre-job submittals.
   14.3.2. Waste manifest(s).
   14.3.3. Asbestos Waste Shipment Record (CN-1054) as required by TN Rule 1200-03-11-.02.
   14.3.4. Personal air monitoring data.
   14.3.5. Supervisor’s log book documenting all required testing, inspections and significant events.

15. General

15.1. The contractor shall be responsible for damage to any surfaces that are not to be demolished/abated.
15.2. Comply with all applicable federal, state and local regulations.
15.3. The TDEC, Division of Air Pollution Control maintains jurisdiction over State regulations and other EPA regulations concerning asbestos. Air Pollution Control form CN-1055 must be submitted before work may begin.

End of Specification
Appendix I – Figure
REFERENCE:
GIS BASE LAYERS WERE OBTAINED FROM DRAWINGS PROVIDED BY CLARK NEXEN, INC. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.
March 26, 2021

Clark Nexsen, Inc.
301 College Street, Suite 300
Asheville, North Carolina 28801

Attention: Mr. Aaron Brumo, AIA, LEED AP BD+C

Reference: Hazardous Materials Assessment
VAMC Building 2 (Ed Allen Hall)
First Floor Renovation
4509 West Stone Drive
Mountain Home, Tennessee
S&M Project No. 211350

Dear Mr. Brumo:

S&M, Inc. (S&M) is pleased to submit this report of professional services provided of the First Floor of the VAMC Building 2 (Ed Allen Hall) on the VAMC campus in Mountain Home, Tennessee. The hazardous material assessment services were conducted as outlined in S&M Proposal No. 211350, dated February 10, 2021, and S&M’s Agreement for Services (AS-071) of the same date. S&M appreciates this opportunity to work with you on this project and we look forward to our continued association. Please contact us at 423-349-2817 if you have questions concerning this report.

Sincerely,

S&M, Inc.

Amy L. Charles
Staff Professional

Carol Goldinger Ford
Senior Project Manager

Senior Reviewed by James R. Bruce, CHMM
# Table of Contents

- **Executive Summary** .................................................................................................................. 1

1.0 **Background** .......................................................................................................................... 2

2.0 **Asbestos Assessment** .......................................................................................................... 2

  2.1 Scope of Services .................................................................................................................... 2

  2.2 Methods .................................................................................................................................. 2

  2.3 Results ..................................................................................................................................... 3

3.0 **Paint Assessment** .............................................................................................................. 3

  3.1 Scope of Services .................................................................................................................... 3

  3.2 Methods .................................................................................................................................. 3

  3.3 Results ..................................................................................................................................... 3

4.0 **Regulated Materials, Universal Wastes, and Related Biological Hazards** ....................... 4

  4.1 Polychlorinated Biphenyls (PCBs) .......................................................................................... 4

  4.2 Freon ....................................................................................................................................... 4

  4.3 Universal Wastes ..................................................................................................................... 4

    4.3.1 Batteries ............................................................................................................................. 4

    4.3.2 Mercury-Containing Equipment ......................................................................................... 4

    4.3.3 Bulbs .................................................................................................................................. 4

    4.3.4 Pesticides ............................................................................................................................ 5

    4.3.5 Other Regulated Materials .................................................................................................. 5

  4.4 Related Biological Hazards ....................................................................................................... 5

5.0 **Conclusions and Recommendations** .............................................................................. 5

  5.1 Asbestos .................................................................................................................................. 5

  5.2 Lead-based Paint ...................................................................................................................... 6

  5.3 Regulated Materials, Universal Wastes, and Related Biological Hazards ............................... 7

6.0 **Limitations** .......................................................................................................................... 7

  6.1 Asbestos Assessment Limitations ............................................................................................ 8

  6.2 Paint Assessment Limitations .................................................................................................. 8
Appendices
Appendix I – Tables
Appendix II – Asbestos Analytical Results
Appendix III – Lead Paint Analytical Results
Appendix IV – Representative Photographs
Executive Summary

S&ME, Inc. (S&ME) conducted a pre-renovation hazardous materials assessment at Building 2, First Floor located on the Veterans Affairs Medical Center (VAMC) Campus in Mountain Home, Tennessee. The purpose of the assessment was to identify asbestos-containing materials (ACM), assess for lead-based paint (LBP), and evaluate the building for Environmental Protection Agency (EPA) regulated Universal Wastes, mercury-containing equipment, ozone-depleting substances (Freon), PCB-containing equipment, and other biological hazards prior to planned renovation of the first floor of Building 2 on the VAMC campus.

The results of the hazardous materials assessment indicated the following:

- Asbestos was detected in the thermal system insulation (TSI) observed within the original brick walls of the building.
- Lead-containing paint was detected in the white paint color observed throughout most of the first floor.
- Approximately 74, four-foot, green-tipped, fluorescent bulbs, 25, silver-tipped fluorescent bulbs, and 80, two-foot, green-tipped fluorescent bulbs containing mercury were identified during the assessment.
- Approximately 111 light ballasts (5 brands) were observed, most were labeled “No PCBs” however, approximately six of one brand did not include this label.
- 35 floor and wall heating ventilating and air-conditioning (HVAC) units, 1 refrigerator, and 1 drinking water fountain were observed which may be equipped with freon-containing components.
- Approximately 28 emergency lighting and exit signs were observed on the first floor which may contain batteries.
- Fire alarm systems were observed throughout the first floor which may contain batteries.
- Twelve smoke detectors potentially containing batteries and/or americium were observed on the first floor.
- Forty potential mercury-containing thermostats were observed on the first floor of the building.
1.0 Background

The subject property Building 2, is located on the Veterans Affairs Medical Center (VAMC) campus in Mountain Home, Tennessee. The first floor is planned for future renovations and this floor was generally unoccupied portion of the building encompassing approximately 14,000 square feet. S&ME, Inc. (S&ME) was requested to provide an assessment for the presence of asbestos-containing materials (ACM), lead-based paint (LBP), regulated Universal Wastes, mercury-containing equipment, ozone-depleting substances (Freon), polychlorinated biphenyl (PCB)-containing equipment, and other biological hazardous materials prior to renovation activities.

2.0 Asbestos Assessment

2.1 Scope of Services

S&ME provided a State of Tennessee and Environmental Protection Agency (EPA)-accredited Asbestos Inspector to conduct the asbestos assessment and sample collection of the first floor of the referenced building on March 8 and 9, 2021. Prior to sampling, the building’s interior was evaluated to identify homogeneous areas (HA) of suspect ACM. A homogeneous sampling area is defined as an area of material of the same color, texture, and date of application.

A total of 110 bulk suspect ACM samples with multiple layers were collected for analysis. Sampling of readily accessible materials was performed where permitted.

2.2 Methods

The asbestos assessment was performed to comply with the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations (40 CFR 61 (M)) issued by the U.S. EPA as they pertain to requirements for an asbestos inspection prior to renovation projects.

The asbestos sampling involved identifying and collecting bulk samples from suspect ACM on interior portions of the first floor of Building 2. The samples were documented on a chain-of-custody and submitted for analysis to Scientific Analytical Institute (SAI) in Greensboro, North Carolina a National Voluntary Laboratory Accreditation (NVLAP# 200664-0) accredited asbestos analytical laboratory.

The sampled material was analyzed by EPA Method 600/R-93/116, Polarized Light Microscopy (PLM) utilizing dispersion staining techniques. PLM identifies asbestos content in a sample by identifying and indexing optical and mineralogical characteristics that are unique to one of six legally recognized asbestos minerals. Asbestos content is visually estimated and is reported as a percentage of the area of the sample analyzed. This technique is the method of analysis recommended by the EPA for asbestos identification in bulk samples.

---

1 Accredited by the National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP).
2.3 Results

The assessment included the bulk sampling and analysis of suspect ACM, which consisted of the materials listed on Table 1 included in Appendix I. Of the bulk samples collected and analyzed from the building, asbestos was detected in concentrations greater than one percent (\(>1\%\)) in the thermal system insulation (TSI) observed within the original brick walls of the building structure. The bulk sample laboratory analytical results are provided in Appendix II.

3.0 Paint Assessment

3.1 Scope of Services

S&ME’s staff evaluated the first floor of Building 2 and collected paint chip samples from painted surfaces suspected to contain lead. Various colored paints on surfaces (metal, wood, concrete) were sampled based on similar color regardless of the substrate materials. Five paint chip samples were collected for each different paint color and analyzed for lead by Environmental Protection Agency (EPA) Method 3050B/7000B.

A total of five paint samples were collected from the first floor of Building 2 and were submitted for laboratory chemical analysis for LBP. Sampling of readily accessible painted surfaces was performed where permitted.

3.2 Methods

The paint samples were submitted to Scientific Analytical Institute, Inc. in Greensboro, North Carolina, a National Lead Laboratory Accreditation Program (NLLAP) accredited lead analytical laboratory. The paint samples were analyzed for lead in accordance with EPA Method SW846 7000B.

3.3 Results

The EPA and United States Department of Housing and Urban Development (HUD) standard defined in Title X of the 1992 Housing and Community Development Act designates LBP as greater than 0.5% lead by weight. The subject building is not considered HUD regulated building. However, it is important to note that, unlike asbestos, the EPA and Occupational Safety and Health Administration (OSHA) does not publish a concentration that is considered “Lead-Based Paint,” and OSHA regulates potential occupational exposures to paint that contains any concentration of lead in accordance with OSHA regulation 29 CFR 1926.62. The survey included the sampling and analysis of paint chips of differentiated surface colors. Lead was reported above the laboratory detection limit in one of five samples submitted for analysis signified lead-containing paint (LCP). Of the paint chip samples collected and analyzed from the subject building, lead in concentrations above HUD designation for LBP was not detected.

4.0 Regulated Materials, Universal Wastes, and Related Biological Hazards

4.1 Polychlorinated Biphenyls (PCBs)

Site observations noted by S&ME indicated that 111 fluorescent light ballasts were identified during the assessment and six ballasts did not contain the “No PCBs” labeling.
In planning for demolition of the building, any light ballasts should be inspected for PCB content prior to disposal. The following criteria are provided to help identify fluorescent light ballasts that may contain PCBs:

- Ballasts manufactured before July 1, 1979.
- Ballasts manufactured between July 1, 1978 and July 1, 1998 that do not contain PCBs must be labeled "No PCBs." Ballasts manufactured after 1998 are not required to be labeled.
- If a ballast is not labeled "No PCBs," it is appropriate to assume it contains PCBs unless it is known to be manufactured after 1979.

If the ballasts cannot be determined to be non-PCB using the above criteria, they should be assumed to contain PCBs and should be handled and disposed as PCB-containing per applicable state and federal regulation.

Disposal of PCBs at concentration of 50 parts per million (ppm) or greater are regulated according to the Toxic Substances Control Act (TSCA), 15 U.S.C. 2601 and set forth in Part 761 of Title 40 of the Code of Federal Regulations (40 C.F.R Part 761). The disposal of PCBs at concentrations of 50 ppm or greater in a Subtitle D Sanitary Landfill is not permitted. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires notification when more than one pound (approximately 12 to 16 ballasts) of PCBs are to be disposed.

4.2 Freon

Site observations noted by S&ME indicated possible Freon-containing equipment including heating, ventilating, and air conditioning (HVAC) wall and floor units, refrigerators, and a drinking water fountain were identified during the assessment.

4.3 Universal Wastes

The federal universal waste regulations are set forth in Part 273 Title 40 of the Code of Federal Regulations (40 C.F.R. 273). Materials regulated under this rule include batteries, pesticides, mercury-containing equipment, and bulbs (lamps).

4.3.1 Batteries

Approximately 28 emergency exit and light systems were observed on the first floor of the building which may contain batteries. Twelve potential battery-containing smoke detectors were observed during the assessment on the first floor. If additional smoke detectors are observed during demolition, the batteries contained within shall be removed and included in the Universal Waste disposal efforts.

4.3.2 Mercury-Containing Equipment

Approximately 74, four-foot green-tipped fluorescent bulbs, 25, silver tipped fluorescent bulbs, and 80, two-foot green-tipped fluorescent bulbs containing mercury were identified during the assessment. Forty potential mercury-containing thermostats were observed on the first floor of the building.

4.3.3 Bulbs

No light bulbs other than those listed in Section 4.3.2 were identified during the assessment.
4.3.4 **Pesticides**

No pesticides were observed in the building during the assessment.

4.3.5 **Other Regulated Materials**

No other regulated materials were observed in the building during the assessment.

4.4 **Related Biological Hazards**

Evidence of insect, bird, rodent, or animal habitation was not observed in the building. Visible mold was not observed in this building.

5.0 **Conclusions and Recommendations**

5.1 **Asbestos**

ACM was detected in the TSI observed within the original brick walls of the building structure. The TSI was visible behind a plastic panel board where ceramic tile had been removed for plumbing purposes on the western portion of the women's bathroom wall (Room 107A).

S&M identified suspect ACM based on the observed condition (good, fair or poor) and potential for disturbance due to the scheduled renovation (high or low). Identified ACM were also categorized based on the EPA's NESHAP regulation categories. Friable ACM is classified as an ACM that can be crumbled to a powder by moderate hand pressure. Non-friable ACM is classified as either Category I Non-friable ACM or Category II Non-friable ACM. Category I and Category II Non-friable ACM are distinguished from each other by their fiber release potential when damaged. Generally, Category I Non-friable ACM, which by definition are products that have been determined to contain greater than one percent asbestos by PLM and are non-friable by hand pressure, includes intact ACM roofing materials, gaskets, packing, and resilient floor coverings. Category II Non-friable ACM include all other non-friable ACM excluding Category I that have a high probability of being rendered friable during removal activities or demolition. All Friable ACM, Category I Non-friable ACM that has become friable, Category I Non-friable ACM that will be or has been subjected to sanding, grinding, cutting or abrading, or Category II Non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations are considered to be a Regulated Asbestos-containing Material (RACM). The NESHAP category for each identified and assumed ACM is provided in Table 6-1 below. For a complete listing of samples collected and analyzed, please see Table 1 in Appendix I. Copies of the analytical results are provided in Appendix II. Representative photographs are presented in Appendix IV.
### Table 5-1 Identified Asbestos-containing Materials

<table>
<thead>
<tr>
<th>HA</th>
<th>Material Description</th>
<th>^Location</th>
<th>^Quantity</th>
<th>^Type</th>
<th>Cond / PD</th>
<th>NESHAP Category</th>
<th>Percent &amp; Type Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Fibrous Pipe Joint Insulation w/ Gray Coating</td>
<td>Potentially hidden in the brick walls throughout the building- visible in Bathroom 107A</td>
<td>~5 LF Visible</td>
<td>TSI</td>
<td>Poor High</td>
<td>F</td>
<td>40% Chrysotile</td>
</tr>
<tr>
<td>26</td>
<td>Papered Layered Pipe Insulation w/ black felt</td>
<td>Potentially hidden in the brick walls throughout the building- visible in Bathroom 107A</td>
<td>~5 LF Visible</td>
<td>TSI</td>
<td>Poor High</td>
<td>F</td>
<td>40% Chrysotile</td>
</tr>
<tr>
<td>27</td>
<td>Paper pipe insulation w/ cloth and white fibrous material</td>
<td>Potentially hidden in the brick walls throughout the building- visible in Bathroom 107A</td>
<td>~5 LF Visible</td>
<td>TSI</td>
<td>Poor High</td>
<td>F</td>
<td>20% Chrysotile</td>
</tr>
</tbody>
</table>

**HA** = Homogeneous Area  
**SF** = Square feet  
**LF** = Linear feet  
**CF** = Cubic Feet

^aRefer to Appendix I, Table 1 for specific sample locations.

^bQuantities are approximate and should not be used for cost estimates or bidding purposes.

^cType: Misc. = Miscellaneous Sur = Surfacing TSI = Thermal System Insulation

^dCond = Condition: Good, Fair or Poor  
PD = Accessible during renovation or demolition with Potential for Disturbance; Low or High

As is the case with any asbestos inspection, materials that were not readily apparent or were located in concealed locations may not have been identified. If any material that is suspected to contain asbestos and was not included in this report as a material identified and tested, is discovered, it should be evaluated for asbestos content before it is disturbed. Therefore, those areas should be assumed to contain asbestos until tested and confirmed not to contain asbestos. The ACMs identified were later labeled with the letters “ACM” once the laboratory results were received.

If non-sampled suspect materials are discovered during demolition that are similar to the sampled materials in appearance, age or use, they should be treated the same as the similar sampled materials.

### 5.2 Lead-based Paint

A total of five paint chip samples were collected during this survey. Lead was reported above laboratory detection limit in one of the five samples (white paint) indicating LCP. The remaining four samples indicated lead at concentrations less than the laboratory’s detection limit. For a complete listing of samples collected and analyzed,
please see Table 2 in Appendix I. Copies of the analytical results are provided in Appendix III. Representative photographs are presented in Appendix IV.

Current Tennessee Department of Environment and Conservation (TDEC) regulations and policy indicate that if lead paint is adhered to renovation/demolition debris surfaces and not lose or peeling, the debris can be disposed in a Class I, II, III, or IV disposal facility, and lead paint removal or testing is not required to determine hazardous leaching potential before disposal. However, if LBP removal is anticipated as part of any renovation activity, the removal should be conducted by a State licensed LBP abatement contractor in accordance with local, state and federal laws and guidelines. S&ME recommends contacting a licensed LBP contractor for abatement of affected LBP materials prior to beginning renovation or demolition activities.

The paint coatings tested that exhibited detectable levels of lead may be applicable to OSHA regulation 29 CFR 1926.62. Work activities affecting LCP-coated surfaces (e.g., component removal, manual renovation, paint surface preparation, etc.), should be performed in accordance with OSHA, including but not limited to training, initial exposure monitoring, the use of personal protective equipment, and medical surveillance.

5.3 Regulated Materials, Universal Wastes, and Related Biological Hazards

It is recommended that equipment containing Freon, batteries, and mercury be managed by qualified personnel and properly disposed or recycled in accordance with the applicable EPA regulations regarding universal wastes.

In planning for renovation of the building, all ballasts should be inspected for PCB content prior to disposal. If the ballasts cannot be determined to be non-PCB, they should be assumed to contain PCBs. All ballasts should be handled and recycled/disposed per applicable state and federal regulation. Representative photographs are presented in Appendix IV.

6.0 Limitations

This report is provided for the sole use of Clark Nexsen, Inc and only included the first floor of Building 2. Use of this report by any other parties will be at such party’s sole risk, and S&ME disclaims liability for any such use or reliance by third parties. The results presented in this report are indicative of conditions only during the time of the assessment and of the specific areas referenced.

This report has been prepared in accordance with generally accepted practice for specific application to this project. The conclusions and/or recommendations contained in this report are based on our understanding of the applicable standards at the time this report was prepared. No other warranty, express or implied, is made.

The findings of the hazardous materials evaluation are based largely on visual observations within the amount of time available. The findings do not warrant that all hazardous materials have been identified; ACMs, LBPs, and LCP could be present in areas not readily accessible to observation. In addition, the actual locations and quantities of materials determined to contain asbestos, and LCP will vary from those herein. Apparent homogeneous sampling areas may vary in actual asbestos content due to previous renovations, maintenance, or related operations.

If additional suspect materials are found, our firm should be notified so that our findings can be reviewed for modification or verification.
6.1 Asbestos Assessment Limitations

Although PLM/Dispersion Staining (Method EPA 600/R 93/116) is the specified method for analysis of bulk material samples for asbestos under the EPA, there have been reports that this method may not identify asbestos when fiber sizes are extremely small or if they are bound in a resinous material. EPA recommends analyzing such materials (asphaltic roofing) using Transmission Electron Microscopy (TEM) when PLM analysis does not detect asbestos in quantities greater than 1%. Current EPA regulations do not require this additional analysis and the decision to do so is left to the client.

This report is not intended for use as an asbestos removal specification. The quantities of ACM (if any) provided in this report are estimates for sample collection purposes and should not be used for asbestos abatement bidding purposes. The Asbestos Abatement Contractor is responsible for verifying the quantities of ACM for asbestos abatement purposes.

It is not within the scope of this work to describe all appropriate precautions, safeguards and regulations relating to asbestos. This report is not intended for use as an asbestos abatement specification or bid solicitation document. Prior to asbestos abatement, S&ME recommends that an appropriately qualified and credentialed asbestos designer develop a removal plan.

6.2 Paint Assessment Limitations

As is the case with lead paint inspections, surfaces that were not readily apparent or were located in concealed locations may not have been identified. If any additional coating that is suspected to be LCP or LBP is discovered and was not included in this report as a tested surface, it should be evaluated before it is disturbed.

The limited lead paint sampling was intended to identify those surfaces that contain normally detectible levels of lead in paint. No method of analysis or testing of paint can verify that there is no lead in paint. Such testing or analysis is always subject to a minimum detection limit that is greater than zero; therefore, it is not possible to determine that OSHA regulations will not apply based upon paint testing and/or analysis alone.

The lead paint sampling was not intended to and did not evaluate employee exposure to LBP. For that, lead air monitoring is required. This report is not intended for guidance in complying with OSHA regulations or standards pertaining to lead in paint. It is not within the scope of this work to describe precautions, safeguards, and regulations relating to LCP. These services are available but were not included within the Scope of Services.
Appendices
Appendix I – Tables

Table 1: Summary of Asbestos Sampling Results

Table 2: Summary of Paint Sampling
### Table 1 - Summary of Asbestos Sampling

<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Material Location</th>
<th>Quantity</th>
<th>1Category (F/I/II)</th>
<th>2Type</th>
<th>3Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>4Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12&quot;X12&quot; Beige/pink vinyl tile flooring layered w/ linoleum and black and yellow mastic</td>
<td>Corridor 132; Room 127</td>
<td>~2500 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor / High</td>
<td>HA1-38A</td>
<td>East Side of Entrance to Hallway- Corridor 132</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA1-38B</td>
<td>West Side of Entrance to Hallway-Corridor 132</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12&quot;X12&quot; White/blue specs vinyl tile flooring layered w/ linoleum and w/ black and yellow mastic</td>
<td>Hallways: 131, 100B, 133</td>
<td>~2500 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor / High</td>
<td>HA2-38A</td>
<td>East Side of Entrance to Hallway 131</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA2-38B</td>
<td>West Side of Entrance to Hallway 131</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4&quot; beige/pink vinyl cove base layered w/ linoleum and w/ yellow and white mastic</td>
<td>Corridor 132; Room 127</td>
<td>~600 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA3-38A</td>
<td>East Side of Entrance to Hallway- Corridor 132</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA3-38B</td>
<td>West Side of Entrance to Hallway-Corridor 132</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected  
N/A = Not Applicable  
SF = Square feet  
LF = Linear feet  
CF = Cubic Feet  
1Category:  
F = Friable  
I = Category I, Non-Friable  
II = Category II, Non-Friable  
2Type:  
Misc. = Miscellaneous  
Sur = Surfacing  
TSI = Thermal System Insulation  
3Condition:  
Good, Fair or Poor  
Accessible during renovation or demolition with Potential for Disturbance; Low or High  
Quantities are approximate and should not be used for cost estimates or bidding purposes.
<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Material Location</th>
<th>Quantity</th>
<th>¹Cat (F/I/II)</th>
<th>Type</th>
<th>³Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>⁴Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4” dark blue vinyl cove base layered w/ linoleum and yellow mastic and white leveling compound</td>
<td>Hallways: 131, 100B, 133</td>
<td>~600 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA4-38A</td>
<td>East Side of Entrance to Hallway 131</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA4-38B</td>
<td>West Side of Entrance to Hallway 131</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1&quot;X1&quot; brown ceramic floor tile w/ white mastic and grout</td>
<td>Rooms: 137, 129D, 129G 125, 123, 118, 116A, 115A, 114A, 113A, 112, 110, 109, 107, 106A, 101</td>
<td>~600 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA5-38A</td>
<td>Room 125</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA5-38B</td>
<td>Room 110</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Layered dark gray carpet w/ yellow mastic (1) over 12”X12” tan vinyl tile w/ yellow mastic (2)</td>
<td>Rooms: 128, 116, 115, 114, 113,</td>
<td>~3000 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA6-38A</td>
<td>Conference Room 128- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA6-38A</td>
<td>Conference Room 128-West</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected  
N/A = Not Applicable  
SF = Square feet  
LF = Linear feet  
CF = Cubic Feet  
¹Category:  
F = Friable  
I = Category I, Non-Friable  
II = Category II, Non-Friable  
²Type:  
Misc. = Miscellaneous  
Sur = Surfacing  
TSI = Thermal System Insulation  
³Condition:  
Good, Fair or Poor  
Accessible during renovation or demolition with Potential for Disturbance; Low or High  
Quantities are approximate and should not be used for cost estimates or bidding purposes.
Table 1 - Summary of Asbestos Sampling

<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Material Location</th>
<th>Quantity</th>
<th>¹Cat (F/I/II)</th>
<th>²Type</th>
<th>³Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>⁴Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Layered 4&quot; black cove base w/ yellow mastic (1) over dark blue carpet w/ yellow mastic (2) and leveling compound; layered over 12&quot;X12&quot; Tan vinyl tile w/ yellow mastic (3)</td>
<td>Rooms: 129, 129B, 129C, 129F</td>
<td>~1200 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/ High</td>
<td>HA7-38A</td>
<td>Room 129B- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA7-38B</td>
<td>Room 129B- West</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1&quot;X1&quot; Blue ceramic tile w/ epoxy</td>
<td>Room 129D</td>
<td>~800 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA8-38A</td>
<td>Room 129D- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA8-38B</td>
<td>Room 129D- West</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Black mastic on particle board</td>
<td>Room: 117</td>
<td>~25 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA9-38A</td>
<td>Mechanical Room 117- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA9-38B</td>
<td>Mechanical Room 117- West</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>White fibrous-internal substance from fire door</td>
<td>Doors throughout building</td>
<td>N/A</td>
<td>TSI</td>
<td></td>
<td>Poor/High</td>
<td>HA10-38A</td>
<td>Right side of door near stairwell 136</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA10-38B</td>
<td>Left side of door near stairwell 136</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected  
N/A = Not Applicable  
SF = Square feet  
LF = Linear feet  
CF = Cubic Feet

¹Category:  
F=Friable  
I=Category I, Non-Friable  
II=Category II, Non-Friable

²Type:  
Misc. = Miscellaneous  
Sur = Surfacing  
TSI = Thermal System Insulation

³Condition:  
Good, Fair or Poor  
Accessible during renovation or demolition with Potential for Disturbance; Low or High

Quantities are approximate and should not be used for cost estimates or bidding purposes.
<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Material Location</th>
<th>Quantity</th>
<th>Category (F/I/II)</th>
<th>Type</th>
<th>Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA11-38B</td>
<td>Room 129D- under sink</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>White drywall w/ joint compound and white caulk</td>
<td>Throughout Interior office walls</td>
<td>~4,000 SF</td>
<td>N/A</td>
<td>Sur.</td>
<td>Poor/High</td>
<td>HA12-38A</td>
<td>Room 125</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA12-38B</td>
<td>Room 124</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA12-38C</td>
<td>Room 123</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA12-38D</td>
<td>Room 122</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA12-38E</td>
<td>Room 121</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA12-38F</td>
<td>Room 120</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA12-38G</td>
<td>Room 119</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>White plaster and grout wall board</td>
<td>Rooms: 100., 100A, 102, 102A, 102B, 102C, 102D</td>
<td>~4,000 SF</td>
<td>N/A</td>
<td>Sur.</td>
<td>Poor/High</td>
<td>HA13-38A</td>
<td>Room 102B-North</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA13-38B</td>
<td>Room 102B-East</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA13-38C</td>
<td>Room 102B-South</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA13-38D</td>
<td>Room 102B-West</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA13-38E</td>
<td>Room 102A-West</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA13-38F</td>
<td>Room 102A-South</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA13-38G</td>
<td>Room 102A-East</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected  
N/A = Not Applicable  
SF = Square feet  
LF = Linear feet  
CF = Cubic Feet  
1Category:  
F = Friable  
I = Category I, Non-Friable  
II = Category II, Non-Friable  
2Type:  
Misc. = Miscellaneous  
Sur = Surfacing  
TSl = Thermal System Insulation  
3Condition:  
Good, Fair or Poor  
Accessible during renovation or demolition with Potential for Disturbance; Low or High  
Quantities are approximate and should not be used for cost estimates or bidding purposes.
## Table 1 - Summary of Asbestos Sampling

<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Material Location</th>
<th>Quantity</th>
<th>Cat (I/I/II)</th>
<th>Type</th>
<th>Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>TSI plaster coating wrap on fiberglass</td>
<td>Corridors; Rooms; above ceiling tiles</td>
<td>~1500 LF</td>
<td>N/A</td>
<td>TSI</td>
<td>Poor/High</td>
<td>HA14-38A</td>
<td>Room 126A- South</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA14-38B</td>
<td>Room 126A- North</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA14-38C</td>
<td>Room 101A- North</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA14-38D</td>
<td>Room 101A-West</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Small worm ceiling tile</td>
<td>Intermixed through 1st floor ceilings</td>
<td>~4,000 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA15-38A</td>
<td>Room 130</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA15-38B</td>
<td>Room 107A</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Medium worm ceiling tile</td>
<td>Intermixed through 1st floor ceilings</td>
<td>~4,000 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA16-38A</td>
<td>Room 130</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA16-38B</td>
<td>Room 116</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Plaster wall surfacing layered with finish and base</td>
<td>Perimeter walls facing the building exterior</td>
<td>~4,000 SF</td>
<td>N/A</td>
<td>Sur.</td>
<td>Poor/High</td>
<td>HA17-38A</td>
<td>Room 125</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA17-38B</td>
<td>Room 124</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA17-38C</td>
<td>Room 123</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA17-38D</td>
<td>Room 122</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA17-38E</td>
<td>Room 121</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA17-38F</td>
<td>Room 120</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA17-38G</td>
<td>Room 119</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>White 4”X4” ceramic tile w/ white mastic</td>
<td>Room 130 and Room 123</td>
<td>~1000 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA18-38A</td>
<td>Room 130</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA18-38B</td>
<td>Room 123</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Large worm ceiling tile</td>
<td>Intermixed through 1st floor ceilings</td>
<td>~4,000 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA19-38A</td>
<td>Room 130</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA19-38B</td>
<td>Room 107A</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected    N/A = Not Applicable    SF = Square feet    LF = Linear feet    CF = Cubic Feet
1Category: F = Friable      I = Category I, Non-Friable      II = Category II, Non-Friable
2Type: Misc. = Miscellaneous   Sur = Surfacing   TSI = Thermal System Insulation
3Condition: Good, Fair or Poor    Accessible during renovation or demolition with Potential for Disturbance; Low or High

Quantities are approximate and should not be used for cost estimates or bidding purposes.
<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Material Location</th>
<th>Quantity</th>
<th>¹Cat (F/I/II)</th>
<th>²Type</th>
<th>³Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>⁴Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Single layer; white plaster duct work surfacing</td>
<td>Intermixed through 1st floor ceilings under ceiling tiles on HVAC ductwork</td>
<td>~500 SF</td>
<td>N/A</td>
<td>Sur.</td>
<td>Poor/High</td>
<td>HA20-38A</td>
<td>Room 107A- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA20-38B</td>
<td>Room 107A- West</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA20-38C</td>
<td>Room 107A- North</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA20-38D</td>
<td>Room 130-East</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA20-38E</td>
<td>Room 130- West</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA20-38F</td>
<td>Room 130- North</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA20-38G</td>
<td>Room 130- South</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>White caulk around black piping</td>
<td>Intermixed throughout 1st floor ceilings</td>
<td>~100 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA21-38A</td>
<td>Room 130</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA21-38B</td>
<td>Room 116</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Black insulation around water line pipes</td>
<td>Intermixed throughout 1st floor ceilings and individual HVAC units</td>
<td>~2000 SF</td>
<td>N/A</td>
<td>N/A</td>
<td>Poor/High</td>
<td>HA22-38A</td>
<td>Room 130</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA22-38B</td>
<td>Room 116</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>2&quot; X 2&quot; Blue ceramic tile layered w/ plaster, grout, and mortar</td>
<td>Bathroom 107A, 107B</td>
<td>~500 SF</td>
<td>N/A</td>
<td>Sur.</td>
<td>Poor/High</td>
<td>HA23-38A</td>
<td>Room 107A-North</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA23-38B</td>
<td>Room 107A- East</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Gray Cementitious HVAC insulation</td>
<td>Bathroom 107A - Janitor Closet</td>
<td>~20 SF</td>
<td>N/A</td>
<td>TSI</td>
<td>Poor/High</td>
<td>HA24-38A</td>
<td>Room 107B-Top</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA24-38B</td>
<td>Room 107B- Bottom</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA24-38C</td>
<td>Room 107B- Left</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected  N/A = Not Applicable  SF = Square feet  LF = Linear feet  CF = Cubic Feet

¹Category:  F=Friable  I=Category I, Non-Friable  II=Category II, Non-Friable

²Type:  Misc. = Miscellaneous  Sur = Surfacing  TSI = Thermal System Insulation

³Condition:  Good, Fair or Poor  Accessible during renovation or demolition with Potential for Disturbance; Low or High

Quantities are approximate and should not be used for cost estimates or bidding purposes.
<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Material Location</th>
<th>Quantity</th>
<th>²Cat (F/I/II)</th>
<th>³Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>⁴Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Fibrous pipe joint insulation w/ gray coating</td>
<td>Potentially hidden throughout brick walls throughout the building-visible in Bathroom 107A</td>
<td>~5 LF Visible</td>
<td>F</td>
<td>TSI</td>
<td>Poor/High</td>
<td>HA25-38A</td>
<td>Room 107A- Top</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA25-38B</td>
<td>Room 107A- Bottom</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA25-38C</td>
<td>Room 107A- Left</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA25-38D</td>
<td>Room 107A- Right</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Layered paper pipe insulation w/ black felt</td>
<td>Potentially hidden throughout brick walls throughout the building-visible in Bathroom 107A</td>
<td>~5 LF Visible</td>
<td>F</td>
<td>TSI</td>
<td>Poor/High</td>
<td>HA26-38A</td>
<td>Room 107A- Top</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA26-38B</td>
<td>Room 107A- Bottom</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA26-38C</td>
<td>Room 107A- Right</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA26-38D</td>
<td>Room 107A- Left</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Paper pipe insulation w/ cloth and friable white material</td>
<td>Potentially hidden throughout brick walls</td>
<td>~5 LF Visible</td>
<td>F</td>
<td>TSI</td>
<td>Poor/High</td>
<td>HA27-38A</td>
<td>Room 107A- Top</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA27-38B</td>
<td>Room 107A- Bottom</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected     N/A = Not Applicable     SF = Square feet     LF = Linear feet     CF = Cubic Feet

¹Category:  F = Friable     I = Category I, Non-Friable     II = Category II, Non-Friable

²Type:     Misc. = Miscellaneous     Sur = Surfacing     TSI = Thermal System Insulation

³Condition:  Good, Fair or Poor     Accessible during renovation or demolition with Potential for Disturbance; Low or High

Quantities are approximate and should not be used for cost estimates or bidding purposes.
### Table 1 - Summary of Asbestos Sampling

<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Location</th>
<th>Quantity</th>
<th>1Cat (F/I/II)</th>
<th>2Type</th>
<th>3Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>4Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>White pipe caulking</td>
<td>Room 107A</td>
<td>~20 LF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA28-38A</td>
<td>Room 107A- Bottom</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA28-38B</td>
<td>Room 107A- Left</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>White and gray cementitious plaster (finish and base) over black wire</td>
<td>Rooms: 130 and 107A- potentially hidden above ceiling tiles</td>
<td>~30 SF</td>
<td>N/A</td>
<td>Sur.</td>
<td>Poor/High</td>
<td>HA29-38A</td>
<td>Room 107A- 1</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA29-38B</td>
<td>Room 107A- 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA29-38C</td>
<td>Room 107A- 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA29-38D</td>
<td>Room 107A- 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA29-38E</td>
<td>Room 107A- 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA29-38F</td>
<td>Room 107A- 6</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA29-38G</td>
<td>Room 107A- 7</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Small pin ceiling tile</td>
<td>Intermixed throughout 1st floor ceilings</td>
<td>~4,000 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA30-38A</td>
<td>Room 107A- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA30-38B</td>
<td>Room 107A- West</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Dark brown cove base w/ yellow mastic</td>
<td>Rooms 100 and 100A</td>
<td>~30 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA31-38A</td>
<td>Room 100</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA31-38B</td>
<td>Room 100A</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Tan carpet w/ white mastic layered beige tile with yellow mastic</td>
<td>Room 100</td>
<td>~1000 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA32-38A</td>
<td>Room 100</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA32-38B</td>
<td>Room 100A</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected  
N/A = Not Applicable  
SF = Square feet  
LF = Linear feet  
CF = Cubic Feet

1Category:  
F=Friable  
I=Category I, Non-Friable  
II=Category II, Non-Friable

2Type:  
Misc. = Miscellaneous  
Sur = Surfacing  
TSI = Thermal System Insulation

3Condition:  
Good, Fair or Poor  
Accessible during renovation or demolition with Potential for Disturbance; Low or High

Quantities are approximate and should not be used for cost estimates or bidding purposes.
Table 1 - Summary of Asbestos Sampling

<table>
<thead>
<tr>
<th>HA ID</th>
<th>Material Description</th>
<th>Material Location</th>
<th>Quantity</th>
<th>¹Cat (F/I/II)</th>
<th>²Type</th>
<th>³Condition/Potential for Disturbance</th>
<th>Sample Number</th>
<th>⁴Sample Location</th>
<th>Type and Percent Asbestos</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>1&quot; Black cove base w/ yellow mastic</td>
<td>Room 116 and between hallways and rooms</td>
<td>~1000 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA33-38A</td>
<td>Room 116- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA33-38A</td>
<td>Room 116- West</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>4&quot; Black cove base w/ yellow mastic</td>
<td>Room 116</td>
<td>~150 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA34-38A</td>
<td>Room 116- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA34-38B</td>
<td>Room 116-West</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Multi-hued blue carpet w/ yellow mastic</td>
<td>Rooms: 130, 129, 129F, 129C, 100A102A, 103, 106, 109</td>
<td>~150 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA35-38A</td>
<td>Room 116- East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA35-38B</td>
<td>Room 116- West</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Black mastic- shower floor</td>
<td>Multiple showers throughout building</td>
<td>~20 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA36-38A</td>
<td>Room 101</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA36-38B</td>
<td>Room 107A</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>White cove base w/ white mastic</td>
<td>Corridors: 132 and 133</td>
<td>~25 SF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA37-38A</td>
<td>Corridor 133-East</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA37-38B</td>
<td>Corridor 133-West</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Toilet piping caulk</td>
<td>Multiple toilets throughout building</td>
<td>~20 LF</td>
<td>N/A</td>
<td>Misc.</td>
<td>Poor/High</td>
<td>HA38-38A</td>
<td>Room 110-1</td>
<td>NAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HA38-38B</td>
<td>Room 110-2</td>
<td></td>
</tr>
</tbody>
</table>

NAD = No Asbestos Detected  
N/A = Not Applicable  
SF = Square feet  
LF = Linear feet  
CF = Cubic Feet

¹Category:  
F = Friable  
I = Category I, Non-Friable  
II = Category II, Non-Friable

²Type:  
Misc. = Miscellaneous  
Sur = Surfacing  
TSI = Thermal System Insulation

³Condition:  
Good, Fair or Poor  
Accessible during renovation or demolition with Potential for Disturbance; Low or High

Quantities are approximate and should not be used for cost estimates or bidding purposes.
# Table 2: Summary of Paint Assessment

<table>
<thead>
<tr>
<th>Area Description</th>
<th>Substrate</th>
<th>Color</th>
<th>Condition</th>
<th>Location</th>
<th>Sample Number</th>
<th>Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drywall</td>
<td>Green</td>
<td>Poor</td>
<td>Ladies Bathroom</td>
<td>LBP-G107A</td>
<td>Room- 107A</td>
<td>&lt;0.0063%</td>
</tr>
<tr>
<td>Drywall</td>
<td>Pink</td>
<td>Poor</td>
<td>Room-122</td>
<td>LBP- P122</td>
<td>Room- 122</td>
<td>&lt;0.0055%</td>
</tr>
<tr>
<td>Drywall</td>
<td>Taupe</td>
<td>Poor</td>
<td>Room-114</td>
<td>LBP-T114</td>
<td>Room- 114</td>
<td>&lt;0.0043%</td>
</tr>
<tr>
<td>Drywall and Plaster Surfacing</td>
<td>White</td>
<td>Poor</td>
<td>Throughout East and West Corridors; Offices, Hallway, Rooms</td>
<td>LBP-W116</td>
<td>Room 116</td>
<td>0.11%</td>
</tr>
<tr>
<td>Drywall and Plaster Surfacing</td>
<td>Cream</td>
<td>Poor</td>
<td>Rooms 100, 100A, and 130</td>
<td>LBP-C100A</td>
<td>Room- 100A</td>
<td>&lt;0.0067%</td>
</tr>
</tbody>
</table>

**NOTE:** A result of ≥5,000 milligrams per kilogram (mg/kg) or ≥0.5% by weight indicates lead-based paint. Any detected quantity of lead indicates lead-containing paint. Because the composition of paint on a surface may vary if the undercoats vary and the limits of the undercoats are not usually observable, the highest result for a painted area should be considered the lead content for that area.
Appendix II – Asbestos Analytical Results
### Bulk Asbestos Analysis

**By Polarized Light Microscopy**


#### Project:
VAMC Building 2-First Floor

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA1-38A - A</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Ashed</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_127</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA1-38A - B</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Black Non Fibrous Homogeneous</td>
<td>Dissolved</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_128</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA1-38B - A</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_131</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA1-38B - B</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Ashed</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_132</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA1-38B - C</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Black Non Fibrous Homogeneous</td>
<td>Dissolved</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_133</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA1-38C</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA2-38A - A</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_135</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA2-38A - B</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow, Gray Non Fibrous Heterogeneous</td>
<td>Dissolved, Crushed</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_137</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

**Approved Signatory**

Scientific Analytical Institute, Inc. 4604 Dundas Dr. Greensboro, NC 27407  (336) 292-3888
## Bulk Asbestos Analysis

**By Polarized Light Microscopy**


### Project:
VAMC Building 2-First Floor

### Customer:
S&ME, Inc. Tri-Cities
644 Eastern Star Rd
Kingsport, TN 37663

### Attn:
Amy Charles
Carol Ford

### Lab Sample ID

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA2-38A - C</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>70% Cellulose</td>
<td>30% Other</td>
<td>Black Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>71961486PLM_138</td>
<td>remnant felt layer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA2-38B - A</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>71961486PLM_139</td>
<td>mastic 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA2-38B - B</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>Yellow, Gray Non Fibrous Heterogeneous</td>
<td>Dissolved, Crushed</td>
</tr>
<tr>
<td>71961486PLM_141</td>
<td>mastic 2/leveling compound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA2-38B - C</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>None Detected</td>
<td>70% Cellulose</td>
<td>30% Other</td>
<td>Black Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>71961486PLM_142</td>
<td>remnant felt layer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA2-38C</td>
<td>vinyl flooring w/black and yellow mastic</td>
<td>Not Analyzed</td>
<td>70% Cellulose</td>
<td>30% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Ashed, Dissolved</td>
</tr>
<tr>
<td>71961486PLM_6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA3-38A</td>
<td>cove base w/ yellow and white mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Ashed, Dissolved</td>
</tr>
<tr>
<td>71961486PLM_143</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA3-38B</td>
<td>cove base w/ yellow and white mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_144</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA3-38C</td>
<td>cove base w/ yellow and white mastic</td>
<td>Not Analyzed</td>
<td>70% Cellulose</td>
<td>30% Other</td>
<td>Black Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>71961486PLM_9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Bulk Asbestos Analysis

**By Polarized Light Microscopy**


Customer: S&ME, Inc. Tri-Cities
644 Eastern Star Rd
Kingsport, TN 37663

Project: VAMC Building 2-First Floor

Attn: Amy Charles
Carol Ford

Lab Order ID: 71961486
Analysis ID: 71961486_PLM
Date Received: 3/12/2021
Date Reported: 3/17/2021
Date Amended: 3/19/2021

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA4-38A</td>
<td>cove base w/ yellow and white mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow, White Non Fibrous Heterogeneous</td>
<td>Dissolved, Crushed</td>
</tr>
<tr>
<td></td>
<td>mastic/leveling compound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA4-38B</td>
<td>cove base w/ yellow and white mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow, White Non Fibrous Heterogeneous</td>
<td>Dissolved, Crushed</td>
</tr>
<tr>
<td></td>
<td>mastic/leveling compound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA5-38A</td>
<td>ceramic floor tile w/ white mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td></td>
<td>ceramic floor tile w/ white mastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA5-38B</td>
<td>ceramic floor tile w/ white mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td></td>
<td>ceramic floor tile w/ white mastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA6-38A -</td>
<td>layered tile and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>A</td>
<td>mastic 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA6-38A -</td>
<td>layered tile and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>B</td>
<td>mastic 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA6-38A -</td>
<td>layered tile and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>A</td>
<td>mastic 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA6-38A -</td>
<td>layered tile and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>B</td>
<td>mastic 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)
# Bulk Asbestos Analysis

**By Polarized Light Microscopy**


<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA7-38A - A</td>
<td>layered cove base and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_160</td>
<td>mastic 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA7-38A - B</td>
<td>layered cove base and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_162</td>
<td>mastic 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA7-38A - C</td>
<td>layered cove base and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_164</td>
<td>mastic 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA7-38B - A</td>
<td>layered cove base and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_165</td>
<td>mastic 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA7-38B - B</td>
<td>layered cove base and carpet w/ yellow mastics</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Yellow Non Fibrous Heterogeneous</td>
<td>Dissolved, Crushed</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_167</td>
<td>mastic 2/leveling compound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA8-38A</td>
<td>ceramic floor tile w/ black and yellow mastic</td>
<td>None Detected</td>
<td>10% Cellulose 90% Other</td>
<td>Gray, Yellow Non Fibrous Homogeneous</td>
<td>Dissolved, Crushed</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_18</td>
<td>epoxy only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA8-38B</td>
<td>ceramic floor tile w/ black and yellow mastic</td>
<td>None Detected</td>
<td>10% Cellulose 90% Other</td>
<td>Gray, Yellow Non Fibrous Homogeneous</td>
<td>Dissolved, Crushed</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_19</td>
<td>epoxy only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA9-38A</td>
<td>black mastic</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Gray Non Fibrous Homogeneous</td>
<td>Dissolved, Crushed</td>
<td></td>
</tr>
<tr>
<td>71961486PLM_20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

---

Megan Javonovich (158)

---

**Approved Signatory**

Scientific Analytical Institute, Inc. 4604 Dundas Dr. Greensboro, NC 27407 (336) 292-3888
# Bulk Asbestos Analysis

**By Polarized Light Microscopy**  

**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Project:** VAMC Building 2-First Floor

Attn: Amy Charles  
Carol Ford

**Lab Order ID:** 71961486  
**Analysis ID:** 71961486_PLM  
**Date Received:** 3/12/2021  
**Date Reported:** 3/17/2021  
**Date Amended:** 3/19/2021

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA9-38B</td>
<td>black mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Gray</td>
<td>Dissolved, Crushed</td>
</tr>
<tr>
<td>HA10-38A</td>
<td>white fibrous-internal substance from fire door</td>
<td>None Detected</td>
<td>30% Cellulose</td>
<td>70% Other</td>
<td>White Fibrous</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>HA10-38B</td>
<td>white fibrous-internal substance from fire door</td>
<td>None Detected</td>
<td>30% Cellulose</td>
<td>70% Other</td>
<td>White Fibrous</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>HA11-38A</td>
<td>black gasket w yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Black, Yellow</td>
<td>Non Fibrous</td>
</tr>
<tr>
<td>HA11-38B</td>
<td>black gasket w yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Black, Yellow</td>
<td>Non Fibrous</td>
</tr>
<tr>
<td>HA11-38C-A</td>
<td>Dry wall w joint compound</td>
<td>None Detected</td>
<td>10% Cellulose</td>
<td>90% Other</td>
<td>Gray</td>
<td>Non Fibrous</td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

**Approved Signatory**

Scientific Analytical Institute, Inc.  
4604 Dundas Dr. Greensboro, NC 27407  
(336) 292-3888  
Page 5 of 20
# Bulk Asbestos Analysis

**By Polarized Light Microscopy**  

**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Project:** VAMC Building 2-First Floor

**Attn:** Amy Charles  
Carol Ford

**Lab Order ID:** 71961486  
**Analysis ID:** 71961486_PLM  
**Date Received:** 3/12/2021  
**Date Reported:** 3/17/2021  
**Date Amended:** 3/19/2021

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA12-38C - B</td>
<td>Dry wall w joint compound</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_168</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non Fibrous Homogeneous</td>
<td></td>
</tr>
<tr>
<td>HA12-38D - A</td>
<td>Dry wall w joint compound</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non Fibrous Homogeneous</td>
<td></td>
</tr>
<tr>
<td>HA12-38D - B</td>
<td>Dry wall w joint compound white layer; no drywall/joint compound</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Crushed</td>
</tr>
<tr>
<td>71961486PLM_169</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non Fibrous Homogeneous</td>
<td></td>
</tr>
<tr>
<td>HA12-38E</td>
<td>Dry wall w joint compound</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non Fibrous Homogeneous</td>
<td></td>
</tr>
<tr>
<td>HA12-38F - A</td>
<td>Dry wall w joint compound drywall &amp; paint only</td>
<td>None Detected</td>
<td></td>
<td>10% Cellulose 5% Fiber Glass</td>
<td>Gray</td>
<td>Crushed</td>
</tr>
<tr>
<td>71961486PLM_31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non Fibrous Homogeneous</td>
<td></td>
</tr>
<tr>
<td>HA12-38F - B</td>
<td>Dry wall w joint compound</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_170</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non Fibrous Homogeneous</td>
<td></td>
</tr>
<tr>
<td>HA12-38G</td>
<td>Dry wall w joint compound</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Crushed</td>
</tr>
<tr>
<td>71961486PLM_32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non Fibrous Homogeneous</td>
<td></td>
</tr>
<tr>
<td>HA13-38A</td>
<td>Plaster and grout wall board</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Crushed</td>
</tr>
<tr>
<td>71961486PLM_33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non Fibrous Homogeneous</td>
<td></td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

**Approved Signatory**

Scientific Analytical Institute, Inc.  4604 Dundas Dr. Greensboro, NC 27407  (336) 292-3888
# Bulk Asbestos Analysis

By Polarized Light Microscopy


## Customer: S&ME, Inc. Tri-Cities
644 Eastern Star Rd
Kingsport, TN 37663

## Project: VAMC Building 2-First Floor

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA13-38B</td>
<td>Plaster and grout wall board</td>
<td>None Detected</td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
<td></td>
</tr>
<tr>
<td>HA13-38C</td>
<td>Plaster and grout wall board</td>
<td>None Detected</td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
<td></td>
</tr>
<tr>
<td>HA13-38D</td>
<td>Plaster and grout wall board</td>
<td>None Detected</td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
<td></td>
</tr>
<tr>
<td>HA13-38E</td>
<td>Plaster and grout wall board</td>
<td>None Detected</td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
<td></td>
</tr>
<tr>
<td>HA13-38F</td>
<td>Plaster and grout wall board</td>
<td>None Detected</td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
<td></td>
</tr>
<tr>
<td>HA13-38G</td>
<td>Plaster and grout wall board</td>
<td>None Detected</td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
<td></td>
</tr>
<tr>
<td>HA14-38A</td>
<td>TSI plaster coating</td>
<td>None Detected</td>
<td>60% Cellulose 20% Fiber Glass</td>
<td>20% Other</td>
<td>White, Silver Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA14-38B</td>
<td>TSI plaster coating</td>
<td>None Detected</td>
<td>60% Cellulose 20% Fiber Glass</td>
<td>20% Other</td>
<td>White, Silver Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
</tbody>
</table>

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)
**Bulk Asbestos Analysis**
By Polarized Light Microscopy

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Lab Sample ID</th>
<th>Lab Notes</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA14-38C</td>
<td>TSI plaster coating</td>
<td>71961486PLM_42</td>
<td>wrap fiberglass</td>
<td>None Detected</td>
<td>60% Cellulose</td>
<td>20% Other</td>
<td>White, Silver Fibrous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA14-38D</td>
<td>TSI plaster coating</td>
<td>71961486PLM_43</td>
<td>wrap fiberglass</td>
<td>None Detected</td>
<td>60% Cellulose</td>
<td>20% Other</td>
<td>White, Silver Fibrous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA15-38A</td>
<td>Small Worm Ceiling Tile</td>
<td>71961486PLM_44</td>
<td></td>
<td>None Detected</td>
<td>40% Cellulose</td>
<td>10% Perlite 10% Other</td>
<td>Gray Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>HA15-38B</td>
<td>Small Worm Ceiling Tile</td>
<td>71961486PLM_45</td>
<td></td>
<td>None Detected</td>
<td>40% Cellulose</td>
<td>10% Perlite 10% Other</td>
<td>Gray Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>HA15-38C</td>
<td>Small Worm Ceiling Tile</td>
<td>71961486PLM_46</td>
<td></td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA16-38A</td>
<td>Medium worm ceiling tile</td>
<td>71961486PLM_47</td>
<td></td>
<td>None Detected</td>
<td>40% Cellulose 5%</td>
<td>10% Perlite 5% Other</td>
<td>Gray Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>HA16-38B</td>
<td>Medium worm ceiling tile</td>
<td>71961486PLM_48</td>
<td></td>
<td>None Detected</td>
<td>40% Cellulose 5%</td>
<td>10% Perlite 5% Other</td>
<td>Gray Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>HA16-38C</td>
<td>Medium worm ceiling tile</td>
<td>71961486PLM_49</td>
<td></td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

Approved Signatory

Scientific Analytical Institute, Inc.  4604 Dundas Dr. Greensboro, NC 27407  (336) 292-3888  Page 8 of 20
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA17-38A - A</td>
<td>Plaster wall surfacing</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Non Fibrous Homogeneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38A - B</td>
<td>Plaster wall surfacing</td>
<td>None Detected</td>
<td></td>
<td>3% Hair</td>
<td>Gray</td>
<td>Non Fibrous Heterogeneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38B - A</td>
<td>Plaster wall surfacing</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Non Fibrous Homogeneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38B - B</td>
<td>Plaster wall surfacing</td>
<td>None Detected</td>
<td></td>
<td>3% Hair</td>
<td>Gray</td>
<td>Non Fibrous Heterogeneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38C - A</td>
<td>Plaster wall surfacing</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Non Fibrous Homogeneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38C - B</td>
<td>Plaster wall surfacing</td>
<td>None Detected</td>
<td></td>
<td>3% Hair</td>
<td>Gray</td>
<td>Non Fibrous Heterogeneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38D</td>
<td>Plaster wall surfacing</td>
<td>None Detected</td>
<td></td>
<td>3% Hair</td>
<td>Gray</td>
<td>Non Fibrous Heterogeneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38E - A</td>
<td>Plaster wall surfacing</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Non Fibrous Homogeneous</td>
</tr>
</tbody>
</table>

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)
# Bulk Asbestos Analysis

By Polarized Light Microscopy

## VAMC Building 2-First Floor

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Lab Sample ID</th>
<th>Lab Notes</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA17-38E - B</td>
<td>Plaster wall surfacing</td>
<td>71961486PLM_174</td>
<td>base</td>
<td>None Detected</td>
<td>3% Hair</td>
<td>97% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38F - A</td>
<td>Plaster wall surfacing</td>
<td>71961486PLM_55</td>
<td>finish</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38F - B</td>
<td>Plaster wall surfacing</td>
<td>71961486PLM_175</td>
<td>base</td>
<td>None Detected</td>
<td>3% Hair</td>
<td>97% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38G - A</td>
<td>Plaster wall surfacing</td>
<td>71961486PLM_56</td>
<td>finish</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA17-38G - B</td>
<td>Plaster wall surfacing</td>
<td>71961486PLM_176</td>
<td>base</td>
<td>None Detected</td>
<td>3% Hair</td>
<td>97% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA18-38A</td>
<td>ceramic floor tile w/ white mastic</td>
<td>71961486PLM_177</td>
<td></td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>Cream Non Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>HA18-38B</td>
<td>ceramic floor tile w/ white mastic</td>
<td>71961486PLM_178</td>
<td></td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>Cream Non Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>HA18-38C</td>
<td>ceramic floor tile w/ white mastic</td>
<td>71961486PLM_59</td>
<td></td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)
## Bulk Asbestos Analysis

**By Polarized Light Microscopy**

**EPA Method:** 600/R-93/116 and 40 CFR, Part 763, Subpart E, App.E

---

**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Project:** VAMC Building 2-First Floor

**Attn:** Amy Charles  
Carol Ford

**Lab Order ID:** 71961486  
**Analysis ID:** 71961486_PLM  
**Date Received:** 3/12/2021  
**Date Reported:** 3/17/2021  
**Date Amended:** 3/19/2021

---

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA19-38A</td>
<td>Large worm ceiling tile</td>
<td>None Detected</td>
<td>40% Cellulose, 40% Fiber Glass, 5% Wollastonite</td>
<td>10% Perlite, 5% Other</td>
<td>Gray Fibrous</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA19-38B</td>
<td>Large worm ceiling tile</td>
<td>None Detected</td>
<td>40% Cellulose, 40% Fiber Glass, 5% Wollastonite</td>
<td>10% Perlite, 5% Other</td>
<td>Gray Fibrous</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA19-38C</td>
<td>Large worm ceiling tile</td>
<td>None Detected</td>
<td>40% Cellulose, 40% Fiber Glass, 5% Wollastonite</td>
<td>10% Perlite, 5% Other</td>
<td>Gray Fibrous</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_62</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA20-38A</td>
<td>Plaster duct work surfacing</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>White Non Fibrous</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_63</td>
<td>single layer plaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA20-38B</td>
<td>Plaster duct work surfacing</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>White Non Fibrous</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_64</td>
<td>single layer plaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA20-38C</td>
<td>Plaster duct work surfacing</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>White Non Fibrous</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_65</td>
<td>single layer plaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA20-38D</td>
<td>Plaster duct work surfacing</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>White Non Fibrous</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_66</td>
<td>single layer plaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
<tr>
<td>HA20-38E</td>
<td>Plaster duct work surfacing</td>
<td>None Detected</td>
<td>100% Other</td>
<td></td>
<td>White Non Fibrous</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_67</td>
<td>single layer plaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crushed</td>
</tr>
</tbody>
</table>

---

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

Approved Signatory

Scientific Analytical Institute, Inc.  
4604 Dundas Dr. Greensboro, NC 27407  
(336) 292-3888
## Bulk Asbestos Analysis

**By Polarized Light Microscopy**  

**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Attn:** Amy Charles  
Carol Ford

**Project:** VAMC Building 2-First Floor

### Sample Analysis

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA20-38F</td>
<td>Plaster duct work surfacing</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Non Fibrous Homogeneous Crushed</td>
</tr>
<tr>
<td></td>
<td>single layer plaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA20-38G</td>
<td>Plaster duct work surfacing</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Non Fibrous Homogeneous Crushed</td>
</tr>
<tr>
<td></td>
<td>single layer plaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA21-38A</td>
<td>white caulk around black piping</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Non Fibrous Homogeneous Ashed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA21-38B</td>
<td>white caulk around black piping</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA21-38C</td>
<td>white caulk around black piping</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA21-38D</td>
<td>white caulk around black piping</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White</td>
<td>Non Fibrous Homogeneous Ashed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA22-38A</td>
<td>black insulation</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Black</td>
<td>Non Fibrous Homogeneous Ashed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA22-38B</td>
<td>black insulation</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

---

**Approved Signatory**  
**Scientific Analytical Institute, Inc.**  
4604 Dundas Dr. Greensboro, NC 27407  
(336) 292-3888

Page 12 of 20
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA22-38C</td>
<td>black insulation</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA22-38D</td>
<td>black insulation</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Black</td>
<td>Ashed</td>
</tr>
<tr>
<td>HA23-38A-A</td>
<td>blue tile w/ white plaster</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Blue</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA23-38A-B</td>
<td>blue tile w/ white plaster</td>
<td>None Detected</td>
<td>100% Other</td>
<td>White</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA23-38A-C</td>
<td>blue tile w/ white plaster</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Gray</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA23-38B-A</td>
<td>blue tile w/ white plaster</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Blue</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA23-38B-B</td>
<td>blue tile w/ white plaster</td>
<td>None Detected</td>
<td>100% Other</td>
<td>White</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA23-38B-C</td>
<td>blue tile w/ white plaster</td>
<td>None Detected</td>
<td>100% Other</td>
<td>Gray</td>
<td>Crushed</td>
</tr>
</tbody>
</table>

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

Approved Signatory
Scientific Analytical Institute, Inc. 4604 Dundas Dr. Greensboro, NC 27407 (336) 292-3888
# Bulk Asbestos Analysis

By Polarized Light Microscopy

**EPA Method:** 600/R-93/116 and 40 CFR, Part 763, Subpart E, App.E

**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Attn:** Amy Charles  
Carol Ford

**Lab Order ID:** 71961486  
**Analysis ID:** 71961486_PLM  
**Date Received:** 3/12/2021  
**Date Reported:** 3/17/2021  
**Date Amended:** 3/19/2021

**Project:** VAMC Building 2-First Floor

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA23-38C</td>
<td>blue tile w/ white plaster</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA23-38D</td>
<td>blue tile w/ white plaster</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA24-38A</td>
<td>Cementatious HVAV insulation</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
</tr>
<tr>
<td>HA24-38B</td>
<td>Cementatious HVAV insulation</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
</tr>
<tr>
<td>HA24-38C</td>
<td>Cementatious HVAV insulation</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
</tr>
<tr>
<td>HA25-38A</td>
<td>Fibrous pipe joint insulation w gray coating</td>
<td>40% Chrysotile</td>
<td></td>
<td>60% Other</td>
<td>Gray Fibrous Heterogeneous Teased</td>
</tr>
<tr>
<td>HA25-38B</td>
<td>Fibrous pipe joint insulation w gray coating</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)
### Bulk Asbestos Analysis

**By Polarized Light Microscopy**


**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Project:** VAMC Building 2-First Floor

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA22-38C</td>
<td>Fibrous pipe joint insulation w/ gray coating</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_195</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA25-38D</td>
<td>Fibrous pipe joint insulation w/ gray coating</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_196</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA26-38A</td>
<td>Paper layered pipe insulation w/ black felt</td>
<td>40% Chrysotile</td>
<td>60% Other</td>
<td></td>
<td>Gray Fibrous Homogeneous</td>
<td>Teased</td>
</tr>
<tr>
<td>71961486PLM_197</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA26-38B</td>
<td>Paper layered pipe insulation w/ black felt</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_198</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA26-38C</td>
<td>Paper layered pipe insulation w/ black felt</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_199</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA26-38D</td>
<td>Paper layered pipe insulation w/ black felt</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA27-38A</td>
<td>Paper pipe insulation w/ cloth and friable white material</td>
<td>20% Chrysotile</td>
<td>60% Cellulose</td>
<td>20% Other</td>
<td>Gray, White Fibrous Heterogeneous</td>
<td>Teased, Ashed</td>
</tr>
<tr>
<td>71961486PLM_201</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA27-38B</td>
<td>Paper pipe insulation w/ cloth and friable white material</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_202</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)
# Bulk Asbestos Analysis

By Polarized Light Microscopy


Customer: S&ME, Inc. Tri-Cities
644 Eastern Star Rd
Kingsport, TN 37663

Project: VAMC Building 2-First Floor

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA27-38C</td>
<td>Paper pipe insulation w/ cloth and friable white material</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_203</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA27-38D</td>
<td>Paper pipe insulation w/ cloth and friable white material</td>
<td>Not Submitted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_204</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA28-38A</td>
<td>Pipe caulk</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_205</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA28-38B</td>
<td>Pipe caulk</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Ashed</td>
</tr>
<tr>
<td>71961486PLM_206</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA28-38C</td>
<td>Pipe caulk</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_207</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA29-38A - A</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>71961486PLM_208</td>
<td>finish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA29-38A - B</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td></td>
<td>2% Hair</td>
<td>98% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
</tr>
<tr>
<td>71961486PLM_234</td>
<td>base</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA29-38B - A</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>71961486PLM_209</td>
<td>finish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

Scientific Analytical Institute, Inc.  4604 Dundas Dr. Greensboro, NC 27407  (336) 292-3888

Page 16 of 20
## Bulk Asbestos Analysis

*By Polarized Light Microscopy*

**EPA Method:** 600/R-93/116 and 40 CFR, Part 763, Subpart E, App.E

**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Atttn:** Amy Charles  
Carol Ford

**Project:** VAMC Building 2-First Floor

**Lab Order ID:** 71961486  
**Analysis ID:** 71961486_PLM

**Date Received:** 3/12/2021  
**Date Reported:** 3/17/2021  
**Date Amended:** 3/19/2021

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA29-38B - B</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td>2% Hair</td>
<td>98% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA29-38C - A</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA29-38C - B</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td>2% Hair</td>
<td>98% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA29-38D - A</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA29-38D - B</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td>2% Hair</td>
<td>98% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA29-38E - A</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>White Non Fibrous Homogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA29-38E - B</td>
<td>cementatious plaster over black wire</td>
<td>None Detected</td>
<td>2% Hair</td>
<td>98% Other</td>
<td>Gray Non Fibrous Heterogeneous</td>
<td>Crushed</td>
</tr>
<tr>
<td>HA29-38F</td>
<td>cementatious plaster over black wire</td>
<td>Not Submitted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

Analyst

Approved Signatory

Scientific Analytical Institute, Inc.  4604 Dundas Dr. Greensboro, NC 27407  (336) 292-3888
### Bulk Asbestos Analysis

**By Polarized Light Microscopy**  

**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Attn:** Amy Charles  
Carol Ford

**Lab Order ID:** 71961486  
**Analysis ID:** 71961486_PLM  
**Date Received:** 3/12/2021  
**Date Reported:** 3/17/2021  
**Date Amended:** 3/19/2021  

**Project:** VAMC Building 2-First Floor

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA29-38G</td>
<td>cementitious plaster over black wire</td>
<td>Not Submitted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_214</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA30-38A</td>
<td>Small Pin Ceiling Tile</td>
<td>None Detected</td>
<td>40% Cellulose</td>
<td>10% Perlite</td>
<td>Gray, Fibrous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40% Fiber Glass</td>
<td>10% Other</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_215</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ashed</td>
</tr>
<tr>
<td>HA30-38B</td>
<td>Small Pin Ceiling Tile</td>
<td>None Detected</td>
<td>40% Cellulose</td>
<td>10% Perlite</td>
<td>Gray, Fibrous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40% Fiber Glass</td>
<td>10% Other</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_216</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ashed</td>
</tr>
<tr>
<td>HA30-38C</td>
<td>Small Pin Ceiling Tile</td>
<td>Not Analyzed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71961486PLM_217</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA31-38A</td>
<td>dark brown cove base w/ yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow, Non Fibrous Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_218</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA31-38B</td>
<td>dark brown cove base w/ yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow, Non Fibrous Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_219</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA32-38A - A</td>
<td>layered flooring w white and brown mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Transparent Non Fibrous Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_220</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA32-38A - B</td>
<td>layered flooring w white and brown mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow, Non Fibrous Homogeneous</td>
</tr>
<tr>
<td>71961486PLM_239</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dissolved</td>
</tr>
</tbody>
</table>

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)  
Approved Signatory  
Scientific Analytical Institute, Inc.  4604 Dundas Dr. Greensboro, NC 27407  (336) 292-3888  
Page 18 of 20
## Bulk Asbestos Analysis

**By Polarized Light Microscopy**

**EPA Method:** 600/R-93/116 and 40 CFR, Part 763, Subpart E, App.E

### Project:

VAMC Building 2-First Floor

### Customer:

S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

### Lab Sample ID

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Asbestos</th>
<th>Fibrous Components</th>
<th>Non-Fibrous Components</th>
<th>Attributes</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA32-38B</td>
<td>layered flooring w white and brown mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Transparent Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>A</td>
<td>clear mastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA32-38B</td>
<td>layered flooring w white and brown mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>B</td>
<td>yellow mastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA33-38A</td>
<td>1” black cove base w/ yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA33-38B</td>
<td>1” black cove base w/ yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA34-38A</td>
<td>4” black cove base w/yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA34-38B</td>
<td>4” black cove base w/yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow Non Fibrous Homogeneous</td>
<td>Dissolved</td>
</tr>
<tr>
<td>HA35-38A</td>
<td>carpet w/ yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow, Gray Non Fibrous Heterogeneous</td>
<td>Dissolved, Crushed</td>
</tr>
<tr>
<td>HA35-38B</td>
<td>carpet w/ yellow mastic</td>
<td>None Detected</td>
<td></td>
<td>100% Other</td>
<td>Yellow, Gray Non Fibrous Heterogeneous</td>
<td>Dissolved, Crushed</td>
</tr>
</tbody>
</table>

### Disclaimer:

Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)
# Bulk Asbestos Analysis

By Polarized Light Microscopy

**EPA Method:** 600/R-93/116 and 40 CFR, Part 763, Subpart E, App.E

---

**Customer:** S&ME, Inc. Tri-Cities  
644 Eastern Star Rd  
Kingsport, TN 37663

**Attn:** Amy Charles  
Carol Ford

**Lab Sample ID** | **Lab Notes** | **Asbestos** | **Fibrous Components** | **Non-Fibrous Components** | **Attributes** | **Treatment**
--- | --- | --- | --- | --- | --- | ---
HA36-38A | black mastic- shower floor | None Detected | 100% Other | Black Non Fibrous Homogeneous | Ashed |
| 71961486PLM_228 |  |  |  |  |  |  |

HA36-38B | black mastic- shower floor | None Detected | 100% Other | Black Non Fibrous Homogeneous | Ashed |
| 71961486PLM_229 |  |  |  |  |  |  |

HA37-38A | white mastic | None Detected | 100% Other | White Non Fibrous Homogeneous | Ashed, Crushed |
| 71961486PLM_230 |  |  |  |  |  |  |

HA37-38B | white mastic | None Detected | 100% Other | White Non Fibrous Homogeneous | Ashed, Crushed |
| 71961486PLM_231 |  |  |  |  |  |  |

HA38-38A | toilet piping caulk | None Detected | 100% Other | White Non Fibrous Homogeneous | Ashed |
| 71961486PLM_232 |  |  |  |  |  |  |

HA38-38B | toilet piping caulk | None Detected | 100% Other | White Non Fibrous Homogeneous | Ashed |
| 71961486PLM_233 |  |  |  |  |  |  |

---

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of “None Detected” by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (158)

---

Approved Signatory

Scientific Analytical Institute, Inc.  
4604 Dundas Dr. Greensboro, NC 27407  
(336) 292-3888

Page 20 of 20
### Sample Number | Data 1 | Sample Description |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HA1-38A</td>
<td>beige/pink</td>
<td>vinyl flooring w/black and yellow mastic</td>
</tr>
<tr>
<td>HA1-38B</td>
<td>beige/pink</td>
<td>vinyl flooring w/black and yellow mastic</td>
</tr>
<tr>
<td>HA1-38C</td>
<td>beige/pink</td>
<td>vinyl flooring w/black and yellow mastic</td>
</tr>
<tr>
<td>HA2-38A</td>
<td>white-blue specs</td>
<td>vinyl flooring w/black and yellow mastic</td>
</tr>
<tr>
<td>HA2-38B</td>
<td>white-blue specs</td>
<td>vinyl flooring w/black and yellow mastic</td>
</tr>
<tr>
<td>HA2-38C</td>
<td>white-blue specs</td>
<td>vinyl flooring w/black and yellow mastic</td>
</tr>
<tr>
<td>HA3-38A</td>
<td>beige/pink</td>
<td>cove base w/yellow and white mastic</td>
</tr>
<tr>
<td>HA3-38B</td>
<td>beige/pink</td>
<td>cove base w/yellow and white mastic</td>
</tr>
<tr>
<td>HA3-38C</td>
<td>beige/pink</td>
<td>cove base w/yellow and white mastic</td>
</tr>
<tr>
<td>HA4-38A</td>
<td>dark blue</td>
<td>cove base w/yellow and white mastic</td>
</tr>
<tr>
<td>HA4-38B</td>
<td>dark blue</td>
<td>cove base w/yellow and white mastic</td>
</tr>
<tr>
<td>HA5-38A</td>
<td>brown</td>
<td>ceramic floor tile w/white mastic</td>
</tr>
<tr>
<td>HA5-38B</td>
<td>brown</td>
<td>ceramic floor tile w/white mastic</td>
</tr>
<tr>
<td>HA6-38A</td>
<td>gray carpet; tan vinyl w/ yellow mastics</td>
<td>layered tile and carpet w/yellow mastics</td>
</tr>
<tr>
<td>HA6-38B</td>
<td>gray carpet; tan vinyl w/ yellow mastics</td>
<td>layered tile and carpet w/yellow mastics</td>
</tr>
<tr>
<td>HA7-38A</td>
<td>blue carpet; blue cove base w/yellow mastics</td>
<td>layered cove base and carpet w/yellow mastics</td>
</tr>
<tr>
<td>HA7-38B</td>
<td>blue carpet; blue cove base w/yellow mastics</td>
<td>layered cove base and carpet w/yellow mastics</td>
</tr>
<tr>
<td>HA8-38A</td>
<td>blue/gray</td>
<td>ceramic floor tile w/black and yellow mastic</td>
</tr>
<tr>
<td>HA8-38B</td>
<td>blue/gray</td>
<td>ceramic floor tile w/black and yellow mastic</td>
</tr>
<tr>
<td>HA9-38A</td>
<td>particle board w/black mastic</td>
<td>black mastic</td>
</tr>
<tr>
<td>HA9-38B</td>
<td>particle board w/black mastic</td>
<td>black mastic</td>
</tr>
<tr>
<td>HA10-38A</td>
<td>white fibrous</td>
<td>white fibrous internal substance from fire door</td>
</tr>
<tr>
<td>HA10-38B</td>
<td>white fibrous</td>
<td>white fibrous internal substance from fire door</td>
</tr>
<tr>
<td>HA11-38A</td>
<td>black and yellow</td>
<td>black gasket w/yellow mastic</td>
</tr>
<tr>
<td>HA11-38B</td>
<td>black and yellow</td>
<td>black gasket w/yellow mastic</td>
</tr>
<tr>
<td>HA12-38A</td>
<td>white</td>
<td>Dry wall w/joint compound</td>
</tr>
<tr>
<td>HA12-38B</td>
<td>white</td>
<td>Dry wall w/joint compound</td>
</tr>
<tr>
<td>HA12-38C</td>
<td>white</td>
<td>Dry wall w/joint compound</td>
</tr>
<tr>
<td>HA12-38D</td>
<td>white</td>
<td>Dry wall w/joint compound</td>
</tr>
<tr>
<td>HA12-38E</td>
<td>white</td>
<td>Dry wall w/joint compound</td>
</tr>
<tr>
<td>HA12-38F</td>
<td>white</td>
<td>Dry wall w/joint compound</td>
</tr>
<tr>
<td>HA13-38A</td>
<td>white</td>
<td>Plaster and grout wall board</td>
</tr>
<tr>
<td>HA13-38B</td>
<td>white</td>
<td>Plaster and grout wall board</td>
</tr>
<tr>
<td>HA13-38C</td>
<td>white</td>
<td>Plaster and grout wall board</td>
</tr>
<tr>
<td>HA13-38D</td>
<td>white</td>
<td>Plaster and grout wall board</td>
</tr>
</tbody>
</table>

### Notes:
- Data 1 and Data 2 are optional fields that do not show up on the official report; however, they will be included in the electronic disk returned to you to facilitate your reintegration of the report data.
- Only enter your data on the sheet "Sheet1".
| HA13-38E | white | Plaster and grout wall board | Room 102A-W |
| HA13-38F | white | Plaster and grout wall board | Room 102A-S |
| HA13-38G | white | Plaster and grout wall board | Room 102A-E |
| HA14-38A | cream | TSI plaster coating | Corridor 126A-N |
| HA14-38B | cream | TSI plaster coating | Corridor 126A-N |
| HA14-38C | cream | TSI plaster coating | Corridor 126A-N |
| HA15-38A | white | Small Worn Ceiling Tile | Room 130 |
| HA15-38B | white | Medium Worn Ceiling Tile | Room 130 |
| HA15-38C | white | Medium Worn Ceiling Tile | Room 130 |
| HA16-38A | white | Medium Worn Ceiling Tile | Room 130 |
| HA16-38B | white | Medium Worn Ceiling Tile | Room 130 |
| HA16-38C | white | Medium Worn Ceiling Tile | Room 130 |
| HA17-38A | white | Plaster wall surfacing | Room 130 |
| HA17-38B | white | Plaster wall surfacing | Room 130 |
| HA17-38C | white | Plaster wall surfacing | Room 130 |
| HA17-38D | white | Plaster wall surfacing | Room 130 |
| HA17-38E | white | Plaster wall surfacing | Room 130 |
| HA17-38F | white | Plaster wall surfacing | Room 130 |
| HA17-38G | white | Plaster wall surfacing | Room 130 |
| HA18-38A | white | ceramic floor tile w/ white mastic | Room 130- E |
| HA18-38B | white | ceramic floor tile w/ white mastic | Room 130- E |
| HA18-38C | white | ceramic floor tile w/ white mastic | Room 130- E |
| HA19-38A | white | Large Worn ceiling tile | Room 130 |
| HA19-38B | white | Large Worn ceiling tile | Room 130 |
| HA19-38C | white | Large Worn ceiling tile | Room 130 |
| HA20-38A | white | Plaster duct work surfacing | Room 130 |
| HA20-38B | white | Plaster duct work surfacing | Room 130 |
| HA20-38C | white | Plaster duct work surfacing | Room 130 |
| HA20-38D | white | Plaster duct work surfacing | Room 130 |
| HA20-38E | white | Plaster duct work surfacing | Room 130 |
| HA20-38F | white | Plaster duct work surfacing | Room 130 |
| HA20-38G | white | Plaster duct work surfacing | Room 130 |
| HA21-38A | white caulking | white caulking around black piping | Room 130 |
| HA21-38B | white caulking | white caulking around black piping | Room 130 |
| HA21-38C | white caulking | white caulking around black piping | Room 130 |
| HA21-38D | white caulking | white caulking around black piping | Room 130 |
| HA22-38A | black | black insulation | Room 130 |
| HA22-38B | black | black insulation | Room 130 |
| HA22-38C | black | black insulation | Room 130 |
| HA23-38A | blue ceramic tile - white plaster | blue tile w/ white plaster | Room 130 |
| HA23-38B | blue ceramic tile - white plaster | blue tile w/ white plaster | Room 130 |
Please use this marked up COC and hold the highlighted samples please. Please email to confirm receipt.

Thanks,

Carol
Appendix III – Lead Paint Analytical Results
## Analysis for Lead Concentration in Paint Chips

by Flame Atomic Absorption Spectroscopy

**EPA SW-846 3050B/6010C/7000B**

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Mass (g)</th>
<th>Concentration (ppm)</th>
<th>Concentration (% by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBP-G107A</td>
<td>Room 107A - Green</td>
<td>0.0636</td>
<td>&lt; 63</td>
<td>&lt; 0.0063%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBP-P122</td>
<td>Room 122 - Pink</td>
<td>0.0729</td>
<td>&lt; 55</td>
<td>&lt; 0.0055%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBP-T114</td>
<td>Room 114 - Taupe</td>
<td>0.0929</td>
<td>&lt; 43</td>
<td>&lt; 0.0043%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBP-W116</td>
<td>Room 116 - White</td>
<td>0.0664</td>
<td>1100</td>
<td>0.11%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBP-C 1004</td>
<td>Room 100A - Cream</td>
<td>0.0595</td>
<td>&lt; 67</td>
<td>&lt; 0.0067%</td>
</tr>
</tbody>
</table>

Unless otherwise noted blank sample correction was not performed on analytical results. Scientific Analytical Institute participates in the AIHA ELPAT program, ELPAT Laboratory ID: 173190. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. Analytical uncertainty available upon request. The quality control samples run with the samples in this report have passed all EPA required specifications unless otherwise noted. RL: (Report Limit for an undiluted 50ml sample is 4µg Total Pb). Unless indicated, areas and volumes were provided by the customer.
**Contact Information**

<table>
<thead>
<tr>
<th>Company Name:</th>
<th>S&amp;ME, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>644 Eastern Star Road, Kingsport, TN 37663</td>
</tr>
<tr>
<td>Contact:</td>
<td>Carol Ford</td>
</tr>
<tr>
<td>Phone:</td>
<td>423-349-2817</td>
</tr>
<tr>
<td>Fax:</td>
<td></td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:cford@smeinc.com">cford@smeinc.com</a></td>
</tr>
<tr>
<td>PO Number:</td>
<td>4140-17-036</td>
</tr>
<tr>
<td>Project Name/Number:</td>
<td>PM011 211350</td>
</tr>
</tbody>
</table>

**Billing/Invoice Information**

| Company: | same as to the right |
| Address: |             |
| Contact: | Carol Ford |
| Phone:   | 423-349-2817 |
| Fax:     |             |
| Email:   | cford@smeinc.com |

**Turn Around Times**

<table>
<thead>
<tr>
<th>3 Hours</th>
<th>72 Hours</th>
<th>6 Hours</th>
<th>96 Hours</th>
<th>12 Hours</th>
<th>120 Hours</th>
<th>24 Hours</th>
<th>144+ Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 Hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 Hours</td>
<td>144+ Hours</td>
</tr>
</tbody>
</table>

**Lead Test Types**

- **Paint Chips by Flame AA** (PBP)
- **Soil by Flame AA** (PBS)
- **Other**
- **Air by Flame AA** (PBA)

**Sample ID #**

<table>
<thead>
<tr>
<th>Sample ID #</th>
<th>Description/Location</th>
<th>Volume/Area</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBP-G 407A</td>
<td>Room 407A - Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBP - P K2</td>
<td>Room 122 - Pink</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBP - T H4</td>
<td>Room 114 - Taupe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBP - W N16</td>
<td>Room 116 - White</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBP - L 100A</td>
<td>Room 100A - cream</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Relinquished by**

<table>
<thead>
<tr>
<th>Relinquished by</th>
<th>Date/Time</th>
<th>Received by</th>
<th>Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amy Carries</td>
<td>4/14/01</td>
<td>J. Simmons</td>
<td>5/12/01</td>
</tr>
</tbody>
</table>

**Total Number of Samples:** 5

**Accepted**

**Rejected**

Page 1 of 1
Appendix IV – Representative Photographs
1. Howard Industries Ballast labeled, "No PCBs"

2. GE Proline Multi-volt Ballast **NOT** labeled, "No PCBs" and assumed to contain PCBs.

3. Advance Ballast labeled "No PCBs"

4. Ultim8 Ballast labeled "No PCBs"
5. Mark III Ballast labeled “No PCBs”

6. Fluorescent light tubes with 3, 4' bulbs per fixture, green tips.

7. Fluorescent Light Tubes with 2, 4' bulbs per fixture.

8. Fluorescent Light Tubes with 2, 4' bulbs per fixture, with green tips.
9 Fluorescent Light Tubes with 2, 2’ bulbs per fixture.

10 Emergency Exit Lighting/Signs assumed to contain batteries

11 Emergency Lighting assumed to contain batteries

12 Fire Alarm Lighting assumed to contain batteries
13 Smoke Detectors assumed to contain batteries

14 Pipes Located within the Interior Brick Walls Assumed to be insulated with asbestos.

15 Bathroom 107- Access to interior brick walls containing ACM TSI – 20% to 40% Chrysotile

16 HA- 25: TSI Pipe Joint Insulation with Gray Coating Contains 40% Chrysotile
HA-26: TSI layered paper insulation with black felt contains 40% Chrysotile

White paint sample containing 0.11% by weight and is considered LCP.

HA-27: TSI Layered Paper Insulation with cloth and white friable material contains 20% Chrysotile

Floor and Ceiling HVAC units, Refrigerators, and Drinking Fountain in Corridor 133 assumed to contain Freon.
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 05 12 00 - 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. Shrinkage-resistant grout.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

2. High-strength, bolt-nut-washer assemblies.
3. Shrinkage-resistant grout.

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.
1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and.

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 materials, including chemical and physical properties.

E. Product Test Reports: For the following:
   1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field 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 BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

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 F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:
   1. ANSI/AISC 303.
   2. ANSI/AISC 360.
   3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:
   1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

C. Construction: Shear wall system.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

2.4 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
   4. Mark and match-mark materials for field assembly.

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. 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.

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.

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 on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Promptly pack shrinkage-resistant 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 grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that 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.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC"s "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type 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.


3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a 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.

2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

END OF SECTION 05 12 00
SECTION 05 53 13 - BAR GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal bar gratings.

B. Related Requirements:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry.

1.2 ACTION SUBMITTALS


B. Shop Drawings:
   1. Include plans, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: 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.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide: Bar Grating as shown on drawings, as manufactured by McNichols, or a comparable product by one of the following:
   1. Nucor Grating
   2. Amico Industrial Products
2.2 PERFORMANCE REQUIREMENTS

2.3 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531

B. Welded Type 304 Stainless Steel Grating:
   1. Bearing Bar Spacing: 1-3/16 inches o.c.
   2. Bearing Bar Depth: 1 inch
   3. Bearing Bar Thickness: 1/8 inch
   4. Crossbar Spacing: 4 inches o.c.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless steel fasteners for fastening aluminum.
   2. Provide stainless steel fasteners for fastening stainless steel.

B. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ISO 3506-1) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1)

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M), and, where indicated, flat washers.

2.5 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. 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 material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.
E. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

F. Do not notch bearing bars at supports to maintain elevation.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. 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 gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

E. Field Welding: Comply with AWS recommendations and 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.

3.2 INSTALLATION OF METAL BAR GRATINGS

A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

END OF SECTION 055313
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. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Wood blocking and nailers.
4. Wood furring
5. Wood sleepers.
7. Plywood backing panels.
8. Carpentry work not specified as part of other sections and which generally is not exposed, except as otherwise indicated.
9. Miscellaneous lumber for attachment and support of other work to include window installations and cabinet, or equipment installation.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

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 or greater size but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. Lumber Grading Agencies, and the abbreviations used to reference them, including the following:

1. NeLMA: Northeaster Lumber Manufacturer’s Association
2. NLGA: National Lumber Grades Authority
3. RIS: Redwood Inspection Service
4. SPIB: The Southern Pine Inspection Bureau
5. WCLIB: West Coast Lumber Inspection Bureau
6. WWPA: Western Wood Products Association

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
5. Post-installed anchors.
6. Metal framing anchors.

B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicated species and grade selected for each use and design values approved by the ALSC Board of Review.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

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, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded 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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

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 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. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cant s, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
   3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Treatment shall not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
F. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Roof framing and blocking.
3. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
4. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Brace Framing: No. 2 grade.

1. Species:
   a. Southern pine; SPIB.
   b. Spruce-pine-fir; NLGA.
   c. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.5 ENGINEERED WOOD PRODUCTS

A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

B. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
   1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal-depth members.
   2. Modulus of Elasticity, Edgewise: 1,800,000 psi.

2.6 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. Furring
   4. Utility Shelving

B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:

   1. Mixed southern pine or southern pine; SPIB.
   2. Spruce-pine-fir; NLGA.
   3. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   4. Eastern softwoods; NeLMA.
C. Concealed Boards: 19 percent maximum moisture content of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
3. Eastern softwoods, No. 2 Common grade; NELMA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1-inch nominal thickness.

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.


1. Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.9 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a
qualified independent testing agency. Framing anchors shall be punched for fasteners adequate
to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M,
G60 coating designation.

1. Use for interior locations unless otherwise indicated.

2.10 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying
with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl
rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum
foil, or spun-bonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame
Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with
manufacturer's written instructions.

C. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit
carpentry accurately to other construction. Locate furring, nailers, blocking, grounds,
and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities
requiring backing panels. Install fire-retardant-treated plywood backing panels with
classification marking of testing agency exposed to view.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install
fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures,
specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where
framing or blocking does not provide a surface for fastening edges of panels. Space clips
not more than 16 inches on center.
H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches on center with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet on center.

I. 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.

J. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

K. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

L. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

2. ICC-ES evaluation report for fastener.

M. Use steel common 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 between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

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.
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 miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 06 16 00 - 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. Underlayment.
   B. Related Requirements:
      1. Section 061053 "Miscellaneous Rough Carpentry" for plywood backing panels.

1.3 PRE-INSTALLATION MEETINGS
   A. Pre-installation 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.
      1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies 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 plywood complies with requirements. Include physical properties of treated materials.
      3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
      4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
      5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.
1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 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. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subfloor: DOC PS 1, Exposure 1, Underlayment single-floor panels.
   1. Span Rating: Not less than 16.
   2. Nominal Thickness: 1 inch to match existing subfloor
   3. Edge Detail: Tongue & Groove.
B. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch over smooth subfloors and not less than 3/8 inch over board or uneven subfloors.

1. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exposure 1 Underlayment with fully sanded face.
2. Plywood Underlayment for Carpet: DOC PS 1, Exposure 1, Underlayment

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Nails, Brads, and Staples: ASTM F1667.

C. Screws for Fastening Sheathing or underlayment to Wood Framing: ASTM C1002.

D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing or existing wood flooring: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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.

END OF SECTION 06 16 00
SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

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 architectural woodwork at display case
   2. Interior standing and running trim (wood sills at windows and wood base)
   3. Plastic laminate clad cabinets and countertops
   4. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.

B. Related Requirements:
   1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
   2. Section 12 36 61.19 “Quartz Agglomerate Countertops”
   3. Section 018114 High Performance Building Requirements (HPBr) for VOC limits.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Anchors.
2. Adhesives.

B. Shop Drawings:
   1. Include the following:
      a. Dimensioned plans, elevations, and sections.
      b. Attachment details.
   2. Show large-scale details.
   3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and
      reinforcement concealed by construction and specified in other Sections.
   4. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, electrical
      devices and other items installed in architectural woodwork.
   5. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each shop-applied color and finish specified.
   1. Size:
      a. Lumber Products: Not less than 12 inches long, for each species and cut, finished
         on one side and one edge.
   2. Shop applied transparent finishes
   3. Plastic laminates

1.6 INFORMATIONAL SUBMITTALS
A. Qualification Data: For architectural woodwork manufacturer and Installer.
B. Product Certificates: For the following:
   1. Composite wood and agrifiber products.
   2. Adhesives.
C. Field quality-control reports.

1.7 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. Manufacturer's Certification: Licensed participant in AWI's Quality Certification
      Program.
B. Fabricator’s Qualifications: Shop that 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.
C. Source Limitations: Engage a qualified wood-working firm to assume individual responsibility for production of interior architectural woodwork with sequenced matched wood veneers.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where interior architectural woodwork 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.

1.10 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

B. Coordinate all casework with plumbing, mechanical and electrical work associated with the space. Show components that will be attached to the casework, including but not limited to sinks, faucets, plumbing and piping chase, electrical, etc. Field verify conditions and fabricated to the greatest extent in the shop.
PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.

B. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the work.

2.2 MATERIALS

A. General: Provide materials that comply with requirements of quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: Ash, plain sawn or sliced.

C. Wood Species for painted trim or base: Poplar

D. Wood Products: Comply with the following:

1. Medium Density Fiberboard: ANSI A 208.2, Grade MD, made with binder containing no urea formaldehyde.
2. Particleboard: Particleboard complying with requirements in ANSI A208., Grade M-2, except for density.

E. Thermoset Decorative Panels: Particleboard or medium density fiberboard finished with thermally-fused, melamine impregnated decorative paper complying with LMA SAT-1.

F. High Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high pressure decorative laminates by one of the following:

   a. Abet Laminati, Inc.
   b. Arborite, Division of ITW Canada, Inc.
   c. Formica Corporation
   d. Lamin-Art, Inc.
   e. Nevamar Company, LLC; Decorative Products Div.
   f. Panolam Industries International Incorporated
   g. Westinghouse Electric Corporation, Specialty Products Division
   h. Wilsonart International; Div. of Premark International, Inc.
G. Tempered float glass for cabinet doors: ASTM C 1048, Kind FT, Condition A Type I, Class 1 (clear) Quality Q3, with exposed edges seamed before tempering, 6 mm thick, unless otherwise indicated.
   1. Tint Color: Clear

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section “Door Hardware”

B. Frameless Concealed Hinges (European Type): BHMA A 156.9, B01602, 100 degrees of opening.

C. Wire Pulls: Back mounted, solid metal, 4-inches long, 5/16-inch in diameter.

D. Shelf Rests: BHMA A156.9, B04013; metal

E. Drawer Slides: BHMA A156.9, B05091
   1. Heavy Duty (Grade 1HD 100 and Grade 1HD-200) Side mounted, full extension type; zinc-plated steel ball bearing slides.
   2. Box Drawer Slides: Grade 1; for drawers not more than 6-inches high and 24-inches wide.
   3. Keyboard Slides: Grade 1; for computer keyboard shelves.

F. Door Locks: BHMA A156.11, E07121

G. Drawer Locks: BHMA A156.11, E0741.

H. Grommets for cable passage through Countertops: 2-inch, OD, black molded plastic grommets and matching plastic caps with slot for wire passage.

I. 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.

J. For concealed hardware, provide manufacturer’s standard finish that complies with product class requirements in BHMA A156.9.

K. Display Case Hardware
   a. Glass Door Hinges: Basis of Design: Hafele Claronda Item #361.47.207 or approved equal
   b. Finish: Chrome-plated polished
   c. Keyed Glass Door Locks: Basis of Design: Hafele Item #233.21.201 or approved equal
   d. Shelf Supports: Basis of Design: Hafele Item #282.25.733 or approved equal
   e. Material: Zinc die-cast with transparent rubber pad
   f. Finish: Nickel-plated
L. Recessed Display Case Lighting  
   a. Basis of Design: Hafele Loox5 System with associated Driver, distributor, and switch or approved equal  
   b. Recessed housing: Basis of Design: Hafele Item #833.95.722 or approved equal  
      1) For use with LED strip lights up to 5mm wide  
      2) Color: Silver  
      3) End caps  
   c. LED strip light: Basis of Design: Hafele LED 2060 Item #833.74.321 or approved equal  
      1) Voltage: 12V  
      2) Color Temperature: 3000K  
      3) Wattage: 4.8 W/m  
      4) Luminous Efficacy: 460lm/m  

2.4 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH  
A. Architectural Woodwork Standards Grade: Custom  
B. Hardwood Lumber:  
   1. Wood Species: Select Ash Hardwood  
      a. Finish: Clear  
      b. Location: Display Case Construction at Lobby  
   2. Wood Species: Paint grade poplar  
      a. Finish: Paint  
      b. Location: Window Sills and recessed base as scheduled  
C. Hardwood Plywood  
   1. Veneer Wood Species: Ash  
   2. Grade: A-1  
   3. Thickness: ¾”, 7-ply  
   4. Finish: Clear  
D. For trim items wider than available lumber, use veneered construction. Do not glue for width.  
E. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finish work.  

2.5 MISCELLANEOUS MATERIALS  
A. Furring, Blocking, Shims, and Nailers: Softwood lumber, kiln-dried to less than 15 percent moisture content.  
B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.  
C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.6 FABRICATION

A. Interior Woodwork Grade: Unless otherwise indicated, provide grade interior woodwork complying with referenced quality standard/

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

D. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:
   a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

E. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
   a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
   b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

F. 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 or cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with s coat of varnish.

G. Install glass to comply with applicable requirements in Division 08 Section “Glazing” and in GANA’s “Glazing Manual.” For glass in wood frames, secure glass with removable stops.
2.7 PLASTIC LAMINATE CLAD CABINETS

A. Grade: Custom

B. Laminate Cladding for Exposed Surfaces: High pressure decorative laminate complying with the following requirements:
   1. Horizontal Surfaces Other Than Tops: Grade HGS
   2. Postformed Surfaces: Grade HGP
   3. Vertical Surfaces: Grade HGS
   4. Edges: Grade HGS

C. Materials for Semi-exposed Surfaces:
   1. Surfaces other than drawer bodies: High pressure decorative laminate, Grade VGS
   2. Drawer sides and backs: Thermoset decorative panels
   3. Drawer bottoms: Thermoset decorative panels

D. Concealed backs of panels with exposed plastic laminate surfaces: High pressure decorative laminate, Grade BKL.

E. Colors, patterns and finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. Basis of Design: Formica 9318-BH Aluminum Brush Finish

F. Provide dust panels of ¼-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.8 PLASTIC LAMINATE CLAD COUNTERTOPS

A. Grade: Custom

B. High Pressure Decorate Laminate Grade: HGS

C. 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 selected by Architect from manufacturer’s full range in the following categories:
      a. Solid colors, with core color same as surface, matte finish
      b. Patterns, matte finish

D. Edge Treatment: Same as laminate cladding on horizontal surfaces

E. Core Material: Plywood

F. Core Material at sinks: Plywood made with exterior glue.
G. Backer sheet: Provide plastic laminate backer sheet, Grade BKL on underside of countertop substrates.

2.9 SHOP FINISHING

A. Grade: Provide finishes of same grade as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this section. Defer only final touchup, cleaning, and polishing until after installation.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

D. Transparent Finish:
   1. AWI Finish System: Catalyzed polyurethane
   2. Staining: Matched approved sample for color
   3. Filled finish for open-grain woods: After staining apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
   4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523/

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

   1. Shim as required with concealed shims.
   2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Scribe and cut woodwork level, plumb, true and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8-inch in 96-inches.

F. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails, or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

G. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.

H. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

I. Standing and Running Trim: Install with minimum number of joints possible, using full length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60-inches long, except where shorter pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
2. Install wall railings on indicated metal brackets securely fastened to wall framing.
3. Install standing and running trim with no more variation from a straight line than 1/8-inch in 96-inch horizontal variation from a true plane.

J. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8-inch in 96-inches sag, bow, or other variations from a straight line.
2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16-inches on center with No. 10 wafer-head screws sized for 1-inch penetrations into wood framing, blocking or hanging strips.

K. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8-inch in 96-inch sag, bow or other variation from a straight line.
2. Secure backsplashes to walls with adhesive.
3. Caulk space between backsplash and wall with sealant specified in Division 07 “Joint Sealants.”
4. Touch up finishing work specified in this section after installation of woodwork. Fill nail holes with matching filler where exposed.
5. Refer to Division 09 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program 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 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

3.5 CLEANING

A. Clean lubricate and adjust hardware.

B. Clean interior architectural woodwork on exposed and semi-exposed surfaces.

END OF SECTION 06 40 23
SECTION 07 21 00 - 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:

1.3 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.
   B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

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 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
5. 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.

C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.2 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. Products: Subject to compliance with requirements, provide one of the following:

   a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
   b. Gemco; Spindle Type.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:
a. AGM Industries, Inc.; TACTOO Adhesive.
b. Gemco; Tuff Bond Hanger Adhesive.

C. Steel Wire: Steel wire friction fit between studs or run across many studs through knockouts, to prevent sagging of friction fit insulation after installation.
   1. Wire: Galvanized Steel wire, 14 gauge minimum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation 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.
   1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

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 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. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. 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.

3.5 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.

3.6 INSULATION SCHEDULE

A. Insulation Type: Unfaced, glass-fiber blanket insulation. Utilize at interior framing systems.

END OF SECTION 07 21 00
SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

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. Fabrication and installation of new sheet metal flashings and trim to provide a permanently watertight roof condition.
   2. Sheet metal pans at Plaster Room pits

B. Related Requirements:
   1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
   2. Section 075423 "Thermoplastic Polyolefin Roofing (TPO)" for materials and installation of sheet metal flashing and trim integral with roofing.

1.3 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.

1.4 PRE-INSTALLATION MEETINGS
A. Pre-installation Conference: Conduct conference at Project site.

   1. A pre-installation conference for all trades associated with the building envelope shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Pre-Installation conference shall be conducted by the CM@R, and shall include the contractor, installers, architect, and all subcontractors whose work are associated with the building envelope.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

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, and counterflashings as applicable.
   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 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.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
1.8 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.

1. For copings and roof edge flashings that are SPRI ES-1 tested or FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

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, eave, including fascia and fascia trim, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories. This may be incorporated into the metal roof mockup.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

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.

1.10 PROJECT CONDITIONS

A. Environmental: Protect building and its components from the elements at all times during the project.

B. Coordination and Scheduling: Coordinate all phases of work to allow continuity of work without delays.

1.11 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 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: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall 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 shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install copings and 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.

D. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

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. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide aluminum-zinc alloy-coated steel sheet according to ASTM A 792, Class AZ50 coating designation, Grade 40; pre-painted by coil-coating process to comply with ASTM A 755.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:
a. 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.

3. Color: As selected by Architect from manufacturer's full range.

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.

5. Provide strippable plastic film to protect finishes during fabrication and installation.

C. 22-gauge materials shall include the following:

1. Sill Flashing
2. Head Flashing
3. Flashing receivers

2.3 WELDED SHEET METAL FABRICATIONS

A. Custom-fabricated sheet metal pans:

1. Location: Plaster Room
2. Dimensions: As shown on drawings
3. 20-gauge stainless steel Type 304 tested in accordance with ASTM A 167
4. Water-tight seams smoothly ground edges and corners

2.4 UNDERLAYMENT MATERIALS

A. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.5 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, 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. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
2. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

3. Sheet metal to wood attachment (exposed): #12 stainless steel, 5/16 HWH with length to penetrate substrate a minimum of 1 ½-inches. Provide with bonded EPDM washer or washer specified below.

4. Sheet metal to wood attachment (concealed): #10 Stainless steel low profile pancake head with length to penetrate substrate a minimum of 1 ½-inches.

5. Sheet metal to light gauge steel attachment: #14-13 DPI stainless steel low profile pancake head of length required to penetrate metal substrate or minimum 1-inch penetration through wood substrates.

6. Sheet metal to sheet metal attachment (exposed): ¼-inch by 7/8-inch carbon steel, self-drilling point, self-tapping, zinc allow hex head screws with bonded EPDM tubular washer under head of fastener, screw heads to match color of wall panel by means of factory applied coating.

C. Concrete and Masonry Anchors: ¼-inch diameter metal based expansion anchor with stainless steel pin of length to penetrate a minimum of 1 ½-inches

D. Washers shall be stainless steel with neoprene gasket backing. Shall be 1/16-inch diameter for use with #12 screws and 5/8-inch diameter concrete and masonry anchors.

E. Rivets: #44 stainless steel rivets with stainless steel mandrel. Length of rivet to properly fasten particular sheet metal components. Exposed rivets shall be factory painted to match adjacent sheet metal.

F. Solder:

1. For Zinc-Tin Alloy-Coated: ASTM B 32, 100 percent tin, with maximum lead content of 0.2 percent, as recommended by sheet metal manufacturer.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. 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.
2. Obtain field measurements for accurate fit before shop fabrication.
3. 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.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: 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.
C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. 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.

E. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

I. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

J. Do not use graphite pencils to mark metal surfaces.

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 UNDERLAYMENT INSTALLATION

A. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. 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. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. 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. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

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. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint
members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. 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."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

H. Rivets: Rivet joints where necessary for strength.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

3.5 ERECTION 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.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. 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.

END OF SECTION 07 62 00
SECTION 07 81 00 - APPLIED FIREPROOFING

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 sprayed fire-resistant materials.
B. Related Requirements:
   1. Section 05 12 00 "Structural Steel Framing"

1.3 DEFINITIONS
A. SFRM: Sprayed fire-resistant materials.

1.4 PREINSTALLATION MEETINGS
A. Pre-installation Conference: Conduct conference at Project site.
   1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
   1. Extent of fireproofing for each construction and fire-resistance rating.
   2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
   3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
   4. Treatment of fireproofing after application.
1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer
B. Product Certificates: For each type of fireproofing.
C. Evaluation Reports: For fireproofing, from ICC-ES.
D. Preconstruction Test Reports: For fireproofing.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
   1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
   2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
   3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
   4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 degrees F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application; or conveyed in a dry state and mixed with atomized water at place of application.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Monokote Type ME-6 as manufactured by W R Grace and Co., Construction Products Division
2. CAFCO 300 or CAFCO BLAZESHEILD II, as manufactured by Isolatek International Corporation
3. Pyrolite 15 High Yield, as manufactured by Carboline Co., Fire Proofing Products Division
4. Type 5 as manufactured by Southwest Vermiculite Co., Inc.

C. Physical Properties: Applied fireproofing shall meet the following physical performance standards:

1. Bond Strength: Minimum 150-lbf/sq. ft. individual bond strength and 200-lbf/sf.ft average cohesive and adhesive strength based on field testing according to ASTM E 736.
2. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E 605.
3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.
5. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 10 or less.
   b. Smoke-Developed Index: 10 or less.
6. Compressive Strength: Minimum 10 lbf/sq. in. according to ASTM E 761.
7. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
8. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
9. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours according to ASTM E 859.
11. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.
12. Sound Absorption: NRC not less than 0.60 according to ASTM C 423 for Type A mounting according to ASTM E 795.
13. Finish and Color: As selected by Architect from manufacturer's full range of offerings.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.

C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Verify that concrete work on steel deck is complete before beginning fireproofing work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.

D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. 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. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistant products after application.
3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
   1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
   2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Metal Decks:
   1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
   2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

G. Extend fireproofing in full thickness over entire area of each substrate to be protected.

H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.

J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

L. Cure fireproofing according to fireproofing manufacturer's written instructions.

M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

N. Finishes: Where indicated, apply fireproofing to produce the following finishes:

   1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

   1. Test and inspect as indicated on Schedule of Special Inspections.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

   1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
   2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturers recommended trowel-applied product.

END OF SECTION 07 81 00
SECTION 07 84 13 - 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.
   B. Section 018114 High Performance Building Requirements (HPBr)

1.2 SUMMARY
   A. Section Includes:
      1. Penetrations in fire-resistance-rated walls.
   B. Related Requirements:
      1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtainwall/floor intersections, and in smoke barriers.
      2. Section 26 05 44 – “Sleeves and Seals for Electrical Raceways and Cabling”

1.3 PRE-INSTALLATION MEETINGS
   A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
      1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS
A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 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 its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS
A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION
A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. General: For penetrations through 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.

B. Rated Systems: Provide through penetration firestop system with the following ratings determined per ASTM E 814 or 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.

2. **T-Rated Systems:** For the following conditions, provide through penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas.
   
   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistance rated shaft enclosures.

3. **L-Rated Systems:** Where through-penetration firestop systems are indicated in smoke barriers, provide through penetration firestop systems with L-ratings of not more than 3.0 cfm/ft² at both ambient temperatures and 400-degrees F.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

   1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture resistant through penetration firestop systems.
   2. For floor penetrations with annular spaces exceeding 4-inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
   3. For penetrations involving insulated piping, provide through penetration firestop systems not requiring removal of insulation.

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 by ASTM E 84.

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 system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

   1. Permanent forming/damming/backing materials.
   2. Substrate primers.
   3. Collars.
   4. Steel sleeves.

F. **Manufacturers:** Subject to compliance with requirements, provide one of the following and meet the requirements of the referenced UL Details:

   2. Hilti, Inc.
   3. Johns Manville
   4. NUCO Inc.
   5. Tremco, Inc., Tremco Fire Protection Systems Group
   6. 3M Fire Protection Products
2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through penetration firestop systems, under conditions of service and application, as demonstrated by through penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Performance Requirements Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
   a. Slag/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 sealant

2. Substrate primers
3. Collars
4. Steel sleeves

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the UL details on the drawings by referencing the types of materials described in this article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as “fill,” “void” or “cavity materials.”

B. Latex Sealants: Single component latex formulations that after cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory assembled collard formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. 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 non-shrinking homogeneous mortar.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system 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: Before installing penetration firestopping systems, clean out openings immediately 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 materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping 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 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 through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of work that would otherwise be permanently strained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system’s seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

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.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
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. Wall Identification: Refer to specification section 099123 “Interior Painting” for wall identification requirements.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners to mount 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.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration 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 fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system 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 systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Refer to drawings for firestopping systems required.

END OF SECTION 07 84 13
SECTION 07 84 43 - 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.

B. Section 018114 High Performance Building Requirements (HPBr)

1.2 SUMMARY

A. Section Includes:
   1. Joints in or between fire-resistance-rated constructions.

B. Related Requirements:
   1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke resistant construction and for wall identification.
   2. Section 07 95 00 "Expansion Control" for fire-resistive architectural joint systems.
   3. Section 07 95 13.13 "Interior Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies for interior floors, walls, and ceilings.
   4. Section 07 95 13.16 "Exterior Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies for exterior building walls, soffits, and parapets.
   5. Section 07 95 13.19 "Parking Deck Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies subject to vehicular traffic.
   6. Section 09 22 16 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 DEFINITION

A. Fire-Stopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gasses through penetrations in fire rated wall and floor assemblies.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.
1.5 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.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each joint firestopping system.

1.7 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.8 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."


1.9 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.

1.10 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) Intertek Group in its "Directory of Listed Building Products."

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. Joints include those installed in or between fire resistance rated walls and floors or floor/ceiling assemblies.
   2. 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. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. 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.

E. VOC Content: Fire Resistive Joint system sealants shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
   1. Architectural Sealants: 250 g/L
   2. Sealant Primers for Non-porous Substrates: 250 g/L
   3. Sealant Primers for Porous Substrates: 775 g/L
2.3 MANUFACTURERS

A. Products: Subject to compliant with requirements, provide one of the following and meet the requirements of the referenced UL Details:

1. Hilti, Inc.
2. Grace Construction Products
3. Tremco, Inc., Tremco Fire Protection Systems Group
4. 3M Fire Protection Products

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-resistant joint systems, clean joints immediately to comply with fire-resistant 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-resistant 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.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistant joint system 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 fire-resistant joint systems seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistant 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:

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 Substantial Completion. 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.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Refer to drawings for firestopping joint systems required.

END OF SECTION 07 84 43
SECTION 07 92 00 - 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.

B. Section 018114 High Performance Building Requirements (HPBr)

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical joint sealants

B. Related Requirements:

1. Section 01 81 14 “High Performance Building Requirements (HPBr)"
2. Section 08 80 00 “Glazing”
3. Section 08 90 00 “Louvers and Vents”
4. Section 09 29 00 “Gypsum Board”
5. Section 09 30 13 “Tiling”
6. Section 26 05 44 “Sleeves and Sleeve Seals for Electrical Raceways and Cabling”

1.3 PRE-CONSTRUCTION TESTING

A. Pre-Construction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contract or affect joint sealants.

1. Use manufacturer’s standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.
1.5 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. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency or performed by a qualified testing agency.

C. Pre-construction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

E. Sample Warranties: For special warranties.

1.7 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.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

D. Envelope Pre-Installation Meeting
1. A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Pre-installation conference shall be conducted by the envelope commissioning agent and shall include the contractor, installers, architect and system manufacturer’s field representative.

1.8 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 degrees 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.

1.9 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 Substantial Completion.

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 Substantial Completion.

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. Joint sealants and sealant primers inside the weather-proofing system shall comply with the requirements of VOC Limits indicated below:
   1. Architectural sealants shall have a VOC Content of 250 g/L or less
   2. Sealant primers of non-porous substrates shall have a VOC content of 250 g/L or less
   3. Sealant primers of porous substrates shall have VOC content of 775 g/L or less

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid applied joint sealant specified, including those referencing ASTM C 920 classification for type, grade, class, and uses related to exposure and joint substrates.

D. Stain Test Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous substrates indicated for Project.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

F. Products: Subject to compliance with requirements, provide products as manufactured by the following:
   1. Tremco, Inc.
   2. BASF Building Systems
   3. Dow Corning Corporation
   4. GE Advanced
   5. Pecora Corporation
   6. Dayton Superior Specialty Chemicals
   7. EMSEAL Joint Systems Limited

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: Single-component, non-sag, plus 50 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
   1. Basis of Design Product: Tremco Incorporated, Spectrum 2 or Spectrum 3
B. Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type M, Grade P, Class 100/50, Uses T and NT.

1. Basis of Design Product: Tremco Incorporated Spectrum 4TS

2.3 NON-STAINING SILICONE JOINT SEALANTS

A. Non-staining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Non-staining, S, NS, 50, NT: Non-staining, single-component, non-sag, plus 50 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Basis of Design Product: Tremco Incorporated, Spectrum 3

2.4 URETHANE JOINT SEALANTS

A. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.

1. Basis of Design Product: Pecora Corporation, Dynatrol II

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Basis of Design Product: Pecora AC-20 + Silicone

2.6 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer’s standard non-sag, paintable, non-staining 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 assemblies according to ASTM E 90.

2.7 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Non-staining; 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), as approved in writing by joint-sealant manufacturer for joint application indicated, 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.

2.8 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: Non-staining, 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.
d. Direct applied finish systems

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. 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 back 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 Non-sag 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.

3.4 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.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 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. Tile control and expansion joints.
   c. Joints between different materials listed above.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.


1. Joint Locations:
   b. Control and expansion joints in unit masonry.
   c. Joints between metal panels.
d. Joints between different materials listed above.
e. Perimeter joints between materials listed above and frames of doors windows and louvers.
f. Control and expansion joints in ceilings and other overhead surfaces.

2. Joint Sealant: Silicone, non-staining, 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:

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.

1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls
   b. Perimeter joints of exterior openings where indicated
   c. Vertical joints on exposed surfaces of interior concrete unit masonry walls and partitions
   d. Perimeter joints between interior wall surfaces and frames of interior doors at windows and elevator entrances

2. Joint Sealant: Latex
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.

1. Joint Locations:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.

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.
SECTION 08 11 13 - HOLLOW METAL 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 hollow-metal work for door and window frames.

B. Related Requirements:

1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.
2. Section 08 80 00 “Glazing”

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, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. 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 hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

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 stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld International, LLC.
2. Apex Industries, Inc.
3. Ceco Door Products; an Assa Abloy Group company.
4. Commercial Door & Hardware Inc.
5. Concept Frames, Inc.
6. Curries Company; an Assa Abloy Group company.
7. Custom Metal Products.
8. Daybar.
10. de La Fontaine Industries.
11. DKS Steel Door & Frame Sys. Inc.
12. Door Components, Inc.
13. Fleming-Baron Door Products.
15. Greensteel Industries, Ltd.
16. HMF Express.
17. Hollow Metal Inc.
22. LaForce, Inc.
23. Megamet Industries, Inc.
24. Mesker Door Inc.
25. Michbi Doors Inc.
26. MPI Group, LLC (The).
27. National Custom Hollow Metal.
29. Philipp Manufacturing Co (The).
30. Pioneer Industries, Inc.
31. Premier Products, Inc.
32. QuietLite, Inc.
33. Republic Doors and Frames.
34. Rocky Mountain Metals, Inc.
35. Security Metal Products Corp.
36. Shanahans Manufacturing Ltd.
37. Steelcraft; an Ingersoll-Rand company.
38. Steward Steel; Door Division.
39. Stiles Custom Metal, Inc.
40. Titan Metal Products, Inc.
41. Trillium Steel Doors Limited.
42. West Central Mfg. Inc.

B. 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.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
   d. Edge Construction: Model 1, Full Flush.
   e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, or polyurethane at manufacturer's discretion.

3. Frames:
   a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
   b. Construction: Face welded.


2.4 SOUND CONTROL 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. Heavy-Duty Acoustic Frames:

1. Materials:
   a. Window frames shall be 1 ¼ in. thick fabricated from not less than 12 gauge steel, reinforced and filled with sound-absorbing acoustic fill. Inside and outside corners shall be mitered and interlocked to hairline measurements, made square, continuously welded, and ground smooth, flush, and invisible.
   
   b. Stops shall be up to 1 inch thick and readily removable, fabricated from not less than 16 gauge rolled steel sections predrilled and aligned with frame to form tight square acoustical joint. Stop fasteners shall be concealed.
   
   c. Acoustic seals for glazing shall be vibration-isolating resilient closed-cell polyethylene foam glazing tape. Glazing tape must be designed to withstand environmental breakdown and maintain an effective seal. Self-contained, sound-absorptive interior perimeter of not less than 22 gauge steel shall be perforated and prefinished black. Desiccant material shall be incorporated into multiple glazed units.
   
   d. Assembly of acoustic window units including frames, stop, glazing, acoustic seals, sound-absorbing material, and concealed fasteners shall take place at the factory to insure required noise reduction is achieved. Glazing shall not need to be removed to facilitate fastening or anchoring at the job site.
   
   e. Finish –Steel window frame assemblies shall receive one shop coat of gray primer. Stainless steel shall not be painted.
f. Lights for single-and double-glazed units shall be minimum \( \frac{1}{4} \) in. laminated safety glass consisting of multi-layer clear float with clear plastic interlayer. Bullet-resistant glazing (if required) shall be certified to meet UL 752 specifications.
   1) (1) layer of 1/2” thick laminated safety glass and one (1) layer of 1/2” laminated safety glass in window unit.

2. Acoustical Performance Characteristics
   a. manufacturer shall submit laboratory test data certifying Sound Transmission Loss and Sound Transmission Class (STC) when tested in accordance with ASTM E 90-90 of not less than the following:
      1) STC 54 min. at Window Type B
      2) STC 60 min. at Window Type C

3. Fabrication
   a. Assemble windows using all welded construction conforming to pertinent requirements of AWS D1-1. Assembly and adjustment of window units, frames, stop, glazing, acoustic seals, sound-absorbing material and concealed fasteners shall be performed at the factory. Each entire unit shall be shipped to the job site ready for installation and subsequent operation.
   b. Reinforce as required to withstand operating loads.
   c. Painting and cleaning:
      1) On surfaces that are inaccessible after assembly, apply protective coating of the manufacturer’s standard rust-inhibitive primer.
      2) After assembly, and prior to inspection, thoroughly clean all surfaces.
      3) After inspection, and completion of repairs and revisions required by the inspection, apply a shop coat of rust inhibitive primer to exposed surfaces.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   3. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2.6 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 15 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

E. 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.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. 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.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, 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 E 136 for combustion characteristics.

J. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 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 Doors:
1. Fire Door Cores: As required to provide fire-protection ratings indicated.
2. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
3. Top Edge Closures: Close top edges of doors with inverted or flush closures at interior doors, and with inverted closures with top cap, or flush closures, at exterior doors, of same material as face sheets.
4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
6. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. 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. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
3. Floor Anchors: Weld anchors to bottom of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
4. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. to match coursing, and as follows:
      1) Two anchors per jamb up to 60 inches high.
      2) Three anchors per jamb from 60 to 90 inches high.
      3) Four anchors per jamb from 90 to 120 inches high.
      4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
   b. 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.
   c. Post-installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
5. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
6. 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.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. 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 doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
   2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. 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. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   4. Provide loose stops and moldings on inside of hollow-metal work.
   5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 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.

2.9 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
   1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.

3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

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 doors and frames to receive nontemplated, mortised, and surface-mounted door 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. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
8. 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. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
   a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
   c. At Bottom of Door: 1/2 inch plus or minus 1/32 inch.
   d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 80 00 "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: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. 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. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13
SECTION 08 14 16 - 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, with and without glazing.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 01 81 14 “High Performance Building Requirements (HPBr)” for VOC limits.
2. Section 08 71 00 “Door Hardware” for Electrical and hardware requirements.
3. Section 08 80 00 “Glazing” for glass view panels in flush wood doors.

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.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.
1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 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.

1.8 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.


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. Ampco.
3. Chappell Door Co.
4. Eggers Industries.
5. General Veneer Manufacturing Co.
7. Haley Brothers, Inc.
8. Ipik Door Company.
10. Marshfield Door Systems, Inc.
11. Mohawk Doors; a Masonite company.
12. Oshkosh Door Company.
13. Poncraft Door Company.
15. VT Industries, Inc.

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 WDMA I.S.1-A, "Architectural Wood Flush Doors."

1. 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. Certified Wood: Flush wood doors shall be certified as "FSC Pure" or "FSC Mixed" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

C. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

D. WDMA I.S.1-A Performance Grade: Heavy Duty.

E. 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.

F. Particleboard-Core Doors (Doors without glazing):
1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.

G. Structural-Composite-Lumber-Core Doors (Doors with glazing):

   a. Screw Withdrawal, Face: 700 lbf

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Custom (Grade A faces).
2. Species: Select white maple.
   a. Stair #1 Door 106 to be Ash.
3. Cut: Plain sliced (flat sliced).
5. Assembly of Veneer Leaves on Door Faces: Running match.
6. Pair and Set Match: Provide for doors hung in same opening.
7. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
9. 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.
10. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.4 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 08 80 00 "Glazing."

2.5 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 on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: WDMA TR-8 UV Cured finish system.
3. Staining: Custom Color to match Graham Wood Door #400
   a. Clear finish on Door #106

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 08 71 00 "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. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
D. 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 08 14 16
SECTION 08 31 13 - 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, materials, individual components and profiles, and finishes.

B. 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.

C. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Access Panel Solutions.
2. Acudor Products, Inc.
3. Alfab, Inc.
4. Babcock-Davis.
5. Cendrex Inc.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
11. Maxam Metal Products Limited.
12. Metropolitan Door Industries Corp.
13. MIFAB, Inc.
14. Milcor Inc.
15. Nystrom, Inc.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges:
   1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
   2. Locations: Ceiling. Provide access panel wherever required to access any concealed mechanical, electrical, plumbing, or fire protection equipment that requires access.
   3. Door Size: Refer to drawings for locations and sizes.
   4. Metallic-Coated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
   5. Frame Material: Same material, thickness, and finish as door.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. 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.

C. 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.

D. Aluminum Sheet: ASTM B 209, 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; with minimum sheet thickness according to ANSI H35.2.

E. Frame Anchors: Same type as door face.

F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
2.3 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. Provide mounting holes in frames for attachment of units to metal or wood framing.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

E. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.4 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 08 31 13
SECTION 08 33 23 - OVERHEAD COILING 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. Service doors.
B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS
A. Product Data: For each type and size of overhead coiling door and accessory.
   1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
   2. Include rated capacities, operating characteristics, and furnished accessories.
B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
   5. Show locations of controls, locking devices, and other accessories.
C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
   1. Include similar Samples of accessories involving color selection.
D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors 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 for both installation and maintenance of units required for this Project.


PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Structural Drawings.

2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
2.3 SERVICE DOOR ASSEMBLY (INTERIOR DOOR)

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
   
   1. Basis-of-Design Product: Subject to compliance with requirements, provide model # 
      FCM by Cookson Company, or comparable product by one of the following:
      
      a. ACME Rolling Doors.
      b. Alpine Overhead Doors, Inc.
      c. Alumatec Pacific Products.
      d. Amarr Garage Doors.
      e. ASTA Door Corporation.
      f. C.H.I. Overhead Doors.
      g. City-Gates.
      h. Clopay Building Products.
      i. Cornell Iron Works, Inc.
      k. Lawrence Roll-Up Doors, Inc.
      l. McKeon Rolling Steel Door Company, Inc.
      m. Metro Door.
      n. Overhead Door Corporation.
      o. QMI Security Solutions.
      p. Raynor.
      q. Southwestern Rolling Steel Door Co.
      r. Wayne-Dalton Corp.

B. Operation Cycles: Door components and operators capable of operating for not less than 
   50,000. One operation cycle is complete when a door is opened from the closed position to the 
   fully open position and returned to the closed position.

C. Door Curtain Material: Grade 40 Steel with ASTM A 653 galvanized steel zinc coating.

D. Door Curtain Slats:
   
   1. Flat profile slats of 2-5/8-inch center-to-center height.
   2. Interior door: No. 5, 20 gauge.

E. Bottom Bar: Two angles, each not less than 2 by 2 by 1/8 inch thick; fabricated from hot-dip 
   galvanized steel and finished to match door.

F. Curtain Jamb Guides: Steel with exposed finish matching curtain slats.

G. Hood: Match curtain material and finish.
   
   1. Shape: Square.

H. Locking Devices: Masterkeyable cylinder operable from coil side of bottom bar.
   
   1. Standard Mortise Cylinder

J. Door Finish:
   1. Powder-Coated Finish. Bonderized coating for prime coat adhesion, and factory applied thermosetting powder coating applied with a minimum thickness of 2.5 mils, over galvanized steel.
      a. Color as selected by Architect from manufacturer's full range.
      b. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL
   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.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION
   A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
      1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
      2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
      3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

   B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.6 HOODS
   A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.

2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

### 2.7 CURTAIN ACCESSORIES

**A. Weatherseals for Exterior Doors:** Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

**B. Push/Pull Handles:** Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

### 2.8 COUNTERBALANCING MECHANISM

**A. General:** Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

**B. Counterbalance Barrel:** Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

**C. Counterbalance Spring:** One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

**D. Torsion Rod for Counterbalance Shaft:** Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

**E. Brackets:** Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.
2.9 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. 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.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
D. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather-resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23
SECTION 08 56 19 – INTERIOR SLIDING PASS 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 window for interior locations.
B. Related Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   2. Section 08 80 00 Glazing.

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: For aluminum windows.
   1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
C. 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.
D. 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.

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
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of materials and finishes beyond normal weathering.

2. Warranty Period:
   a. 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 INTERIOR ALUMINUM SLIDING PASS WINDOWS

A. Basis of design: Design is based on Sharyn Series Frameless Interior Pass-Thru Window manufactured by: C.R. Laurence Co., Inc. (800) 421-6144 Ext. 7760 transaction@crlaurence.com or a comparable product by one of the following:

1. Ready Access
2. The Sliding Door Co.

B. Types: Provide the following types in locations indicated on Drawings:
   1. Horizontal sliding pass.

C. Pass Window Units: Factory fabricated, glazed unit; horizontal sliding type.
   2. Glass: Safety type specified in Section 08 80 00, GLAZING.

D. Hardware: Manufacturer's standard double track header, rollers, guides, push button lock.

2.3 MATERIALS

A. Header: Shall be constructed of 6063-T5 extruded aluminum. Window rolls on top-hung ball bearing rollers. Overall size is to be in accordance with the contract drawings.

B. Finish: All aluminum to be satin anodized.

C. Glazing: The glazing is to be ¼” thickness.

D. Options: Push button lock

E. Models: Sharyn XX. X = sliding panel, O = fixed panel, as viewed from office side.

2.4 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. 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.

2.5 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: 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.
2.6 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. 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 E2112.

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 other adjacent construction.

C. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points for smooth operation.

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 08 56 19
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 08 71 00 – DOOR HARDWARE

GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
   a. Swinging doors.
   b. Sliding doors.

2. Electronic access control system components, including:
   a. Electronic access control devices.

3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section “Alternates” for alternates affecting this section.
2. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
4. Division 26 sections for connections to electrical power system and for low-voltage wiring.
5. Division 28 sections for coordination with other components of electronic access control system.
1.03 REFERENCES

A. UL - Underwriters Laboratories
   1. UL 10B - Fire Test of Door Assemblies
   2. UL 10C - Positive Pressure Test of Fire Door Assemblies
   3. UL 1784 - Air Leakage Tests of Door Assemblies
   4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute
   1. Sequence and Format for the Hardware Schedule
   2. Recommended Locations for Builders Hardware
   3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute
   1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS

A. General:
   1. Submit in accordance with Conditions of Contract and Division 01 requirements.
   2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
   3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.

B. Action Submittals:
   1. Product Data: Product data including manufacturers’ technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
   2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
      a. Wiring Diagrams: For power, signal, and control wiring and including:
         1) Details of interface of electrified door hardware and building safety and security systems.
         2) Schematic diagram of systems that interface with electrified door hardware.
         3) Point-to-point wiring.
         4) Risers.
   3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:

   a. Door Index; include door number, heading number, and Architects hardware set number.
   b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
   c. Type, style, function, size, and finish of each hardware item.
   d. Name and manufacturer of each item.
   e. Fastenings and other pertinent information.
   f. Location of each hardware set cross-referenced to indications on Drawings.
   g. Explanation of all abbreviations, symbols, and codes contained in schedule.
   h. Mounting locations for hardware.
   i. Door and frame sizes and materials.
   j. Name and phone number for local manufacturer's representative for each product.
   k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
      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 fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:

   a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
   b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
      1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.
6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
   a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
   b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in “QUALITY ASSURANCE” article, herein.
   c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in “QUALITY ASSURANCE” article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Name, address, and phone number of local representative for each manufacturer.
   d. Parts list for each product.
   e. Final approved hardware schedule, edited to reflect conditions as-installed.
   f. Final keying schedule
   g. Copies of floor plans with keying nomenclature
   h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
   i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.

1. Where specific manufacturer’s product is named and accompanied by “No Substitute,” including make or model number or other designation, provide product specified. (Note:
Certain products have been selected for their unique characteristics and particular project suitability.)

a. Where no additional products or manufacturers are listed in product category, requirements for “No Substitute” govern product selection.

2. Where products indicate “acceptable manufacturers” or “acceptable manufacturers and products”, provide product from specified manufacturers, subject to compliance with specified requirements and “Single Source Responsibility” requirements stated herein.

B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
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.
4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.

a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.

D. Architectural Hardware Consultant Qualifications: 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 meets these requirements:

1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
2. Can provide installation and technical data to Architect and other related subcontractors.
3. Can inspect and verify components are in working order upon completion of installation.
5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets 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. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.

J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
2. Maximum opening-force requirements:
   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
   b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.

K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.

2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
   a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
   b. Preliminary key system schematic diagram.
   c. Requirements for key control system.
   d. Requirements for access control.
e. Address for delivery of keys.

L. Pre-installation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

M. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
   a. Attendees: Door hardware supplier, door hardware installer, Contractor.
   b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.

2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
   a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Owner’s security consultant, Architect and Contractor.
   b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer’s original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
D. Protection and Damage:
   1. Promptly replace products damaged during shipping.
   2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
   3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

F. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.07 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. 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.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

F. Direct shipments not permitted, unless approved by Contractor.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

   1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
      
      a. Closers:
         1) Mechanical: 25 years.

      b. Automatic Operators: 2 years.

      c. Exit Devices:
         1) Mechanical: 3 years.
2) Electrified: 1 year.

d. Locksets:
   1) Mechanical: 3 years.

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.09 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Maintenance Tools:

1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PRODUCTS

2.01 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Stanley

B. Requirements:

1. Provide five-knuckle, ball bearing hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.

7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.

10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.

11. Provide mortar guard for each electrified hinge specified.

12. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.02 FLUSH BOLTS

A. Manufacturers:

   1. Scheduled Manufacturer: Hager
      Acceptable Manufacturers: Burns, Rockwood, Ives, Trimco

B. Requirements:

   1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.03 MORTISE LOCKS

A. Manufacturers and Products:

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.

2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.

3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

4. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.

5. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

   a. Lever Design: Corbin Russwin - Armstong A9

6. Provide Mortise locks on new doors.

2.04 CYLINDRICAL LOCKS – GRADE 2

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Corbin CL3800 series (No Substitutions)

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 2. Cylinders: Refer to “KEYING” article, herein.

2. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch (13 mm) latch throw. Provide 2-3/8 inches (60 mm) backset where noted of if door or frame detail requires. Provide proper latch throw for UL listing at pairs.

3. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws. Provide levers that operate independently, and have internal return springs to prevent lever sag.

4. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

5. Lever Trim: Solid cast levers and wrought roses on both sides.


7. Tactile Warning (Abrasive): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

8. Provide Cylindrical locks on existing doors.
2.05 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Corbin ED5200 series (No Substitutions)

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to “KEYING” article, herein.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. No plastic inserts are allowed in touchpads.
4. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
5. Provide flush end caps for exit devices.
6. Provide exit devices with manufacturer’s approved strikes.
7. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
8. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
9. Provide cylinder dogging at non-fire-rated exit devices on Doors 200-A Entry only. Provide hex key dogging on all other doors.
10. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
   a. Lever Style: Match lever style of locksets. AST- ASTI
   b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
11. Provide UL labeled fire exit hardware for fire rated openings.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.

2.06 ROLLER LATCHES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:
1. Provide roller latches with 4-7/8 inches (124 mm) strike at single doors to fit ANSI frame prep. If dummy levers are used in conjunction with roller latch mount roller latch at a height as to not interfere with proper mounting and height of dummy lever.

2. Provide roller latches with 2-1/4 inches (57 mm) full lip strike at pair doors. Mount roller in top rail of each leaf per manufacturer’s template.

2.07 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer: Corbin-Russwin
2. Acceptable Manufacturers: No Substitution

B. Requirements:

1. Provide interchangeable cylinders/cores to match Owner’s existing key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.

2. Temporary Construction Cylinder Keying.
   a. Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
      1) Split Key or Lost Ball Construction Keying System.
      2) 3 construction control keys, and extractor tools or keys as required to void construction keying.
      3) 12 construction change (day) keys.
   b. Owner or Owner’s Representative will void operation of temporary construction keys.

2.08 KEYING

1. Master key or Grand master key cylinders and key in groups, unless otherwise specified.

2. Provide 6 masterkeys for each masterkey set. Stamp keys "DO NOT DUPLICATE."

3. Submit proposed keying schedule to Architect. If requested, meet with Owner and Architect to review schedule.

2.09 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Corbin Russwin DC6000 (No Substitutions)

B. Requirements:
1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2 inch (38 mm) diameter with 11/16 inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.10 DOOR TRIM

A. Manufacturers:
   1. Scheduled Manufacturer: Hager
   2. Acceptable Manufacturer: Burns, Ives, Rockwood

B. Requirements:
   1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
   2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
   3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
   4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
   5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
   6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
   7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
   8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.11 PROTECTION PLATES

A. Manufacturers:
   1. Scheduled Manufacturer: Hager
2. Acceptable Manufacturers: Burns, Rockwood, Ives

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
   a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
   b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
   c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.12 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson
2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.13 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.14 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:
   1. Scheduled Manufacturer: Zero International
   2. Acceptable Manufacturers: National Guard, Reese

B. Requirements:
   1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
   2. Size of thresholds:
      a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
      b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
   3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.15 SILENCERS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:
   1. Provide "push-in" type silencers for hollow metal or wood frames.
   2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
   3. Omit where gasketing is specified.

2.16 COAT HOOKS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.
   2. Acceptable Manufacturers: Burns, Rockwood

B. Provide coat hooks on inside of all toilet room and office doors.
2.17 FINISHES

A. Finish: BHMA 613/613E/643E (US10); except:

   1. Hinges at Exterior Doors: BHMA 630 (US32D)
   2. Pivots: US26D (BHMA 626)
   3. Cylindrical Locks on Aluminum Storefront & Basement Doors: US26D (BHMA 626)
   4. Auxiliary Locks on Aluminum Storefront: US26D (BHMA 626)
   5. Door Pulls on Aluminum Storefront: BHMA 630 (US32D)
   6. Door Closers: Powder Coat to Match
   7. Weatherstripping: Dark Bronze Anodized Aluminum
   8. Thresholds: Extruded Architectural Bronze – Mill Finish

EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, 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.

B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

   1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
   2. Field modify and prepare existing door and frame for new hardware being installed.
   3. When modifications are exposed to view, use concealed fasteners, when possible.
   4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

      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: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
      c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.
3.03 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

2. Custom Steel Doors and Frames: HMMA 831.

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

I. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying section.
2. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect’s opening number.
K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. 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 may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.05 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. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.

2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.06 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 door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DEMONSTRATION

A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.08 DOOR HARDWARE SCHEDULE

A. Hardware items are referenced in the following hardware. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

MANUFACTURERS USED AS BASIS OF DESIGN:

LOCKSETS, CLOSERS, EXIT DEVICES CORBIN-RUSSWIN
HINGES STANLEY
DOOR HARDWARE 08 71 00 - 20
CONTINUOUS HINGE                   ROTON- HAGER
OVERHEAD STOP                      GLYNN JOHNSON
KICKPLATES, STOPS                  HAGER
BARN DOOR HARDWARE                 JOHNSON HARDWARE
THRESHOLD, SEALS, SWEEPS           NGP
ELECTOMAGNETIC HOLDER             RIXSON

HARDWARE GROUP 01
MARK: 100E
EACH TO HAVE:
EXISTING DOOR, FRAME & HARDWARE TO REMAIN

HARDWARE GROUP 02
MARK: 107A-E, 107B-E
EACH TO HAVE:
EXISTING DOOR, FRAME & HARDWARE TO REMAIN

HARDWARE GROUP 03
MARK: 108-E
EACH TO HAVE:
EXISTING DOOR, FRAME & HARDWARE TO REMAIN

HARDWARE GROUP 04
MARK: 109-E, 125-E
EACH TO HAVE:
EXISTING DOOR, FRAME & HARDWARE TO REMAIN

HARDWARE GROUP 05
MARK: 101
EACH TO HAVE:
3 HINGES FBB179-4.5X4.5 26D
1 MORTISE LOCK ML2067-NSR X CT6B 626
1 CYLINDER CORE CR8000 X N6 KEYWAY 626
1 CLOSER DC6210 X M54 689
DOOR HARDWARE 08 71 00 - 21
<table>
<thead>
<tr>
<th>Hardware Group</th>
<th>Mark</th>
<th>Each to Have</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARDWARE GROUP 06</td>
<td>109A, 109B</td>
<td>3 Hinges</td>
<td>FBB179-4.5X4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Rim Exit</td>
<td>ED5200A X N955ET X CT6B X M54 X M110 630</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Cylinder</td>
<td>CR3080-178-6 PIN X CT6B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Cylinder Core</td>
<td>CR8000 X N6 KEYWAY 626</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Closer</td>
<td>DC6210 X M54 689</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Kickplate</td>
<td>190S X B4E X CSK 8” X 34” 32D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Wall Stop</td>
<td>230W 626</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Seal</td>
<td>5050 X 17’ B</td>
</tr>
<tr>
<td>HARDWARE GROUP 07</td>
<td>110, 111, 112, 115, 116</td>
<td>3 Hinges</td>
<td>FBB179-4.5X4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Mortise Lock</td>
<td>ML2030-NSR X V20 626</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(With Occupancy Indicator)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Wall Stop</td>
<td>230W 626</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Silencers</td>
<td>307D</td>
</tr>
<tr>
<td>HARDWARE GROUP 08</td>
<td>119, 120, 121, 122, 123, 124, 131, 132, 133, 134, 136</td>
<td>3 Hinges</td>
<td>FBB179-4.5X4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Mortise Lock</td>
<td>ML2067-NSR X CT6B 626</td>
</tr>
</tbody>
</table>

**Door Hardware**

08 71 00 - 22
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Mark</th>
<th>Quantity</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CYLINDER CORE</td>
<td></td>
<td>1</td>
<td>CR8000 X N6 KEYWAY</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td></td>
<td>1</td>
<td>230W</td>
</tr>
<tr>
<td>3</td>
<td>SILENCERS</td>
<td></td>
<td>3</td>
<td>307D</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP 09**

MARK: 105, 113, 135, 137A, 137B

EACH TO HAVE:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Mark</th>
<th>Quantity</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGES</td>
<td></td>
<td>3</td>
<td>FBB179-4.5X4.5</td>
</tr>
<tr>
<td>1</td>
<td>MORTISE LOCK</td>
<td></td>
<td>1</td>
<td>ML2067-NSR X CT6B</td>
</tr>
<tr>
<td>1</td>
<td>CYLINDER CORE</td>
<td></td>
<td>1</td>
<td>CR8000 X N6 KEYWAY</td>
</tr>
<tr>
<td>1</td>
<td>CLOSER</td>
<td></td>
<td>1</td>
<td>DC6210 X M54</td>
</tr>
<tr>
<td>1</td>
<td>KICKPLATE</td>
<td></td>
<td>1</td>
<td>190S X B4E X CSK-8”X34”</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td></td>
<td>1</td>
<td>230W</td>
</tr>
<tr>
<td>3</td>
<td>SILENCERS</td>
<td></td>
<td>3</td>
<td>307D</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP 10**

MARK: 140

EACH TO HAVE:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Mark</th>
<th>Quantity</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONTINUOUS HINGE</td>
<td></td>
<td>1</td>
<td>780-112HDX 1/2WOOD SCREWS X 83 OA CLEAR</td>
</tr>
<tr>
<td>1</td>
<td>MORTISE LOCK</td>
<td></td>
<td>1</td>
<td>ML2067-NSR X CT6B</td>
</tr>
<tr>
<td>1</td>
<td>CYLINDER CORE</td>
<td></td>
<td>1</td>
<td>CR8000 X N6 KEYWAY</td>
</tr>
<tr>
<td>1</td>
<td>CLOSER</td>
<td></td>
<td>1</td>
<td>DC6210 X M54</td>
</tr>
<tr>
<td>1</td>
<td>KICKPLATE</td>
<td></td>
<td>1</td>
<td>190S X B4E X CSK X 8”X34”</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td></td>
<td>1</td>
<td>230W</td>
</tr>
<tr>
<td>1</td>
<td>SEAL</td>
<td></td>
<td>1</td>
<td>5050 X 20’</td>
</tr>
<tr>
<td>1</td>
<td>DOOR BOTTOM</td>
<td></td>
<td>1</td>
<td>335S X 42 W</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td></td>
<td>1</td>
<td>513 X ¼-20 MS/EA X 42</td>
</tr>
</tbody>
</table>

DOOR HARDWARE 08 71 00 - 23
2 JAMB CORNER PADS 60FP

NEW DOOR IN EXISTING FRAME, DOOR TO BE CHANGED TO OPPOSITE HAND

HARDWARE GROUP 11
MARK: 138C
EACH DOOR TO HAVE:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Model/Style</th>
<th>Mark</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Hinges</td>
<td>FBB179-5X4.5</td>
<td>26D</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Flushbolt (Top)</td>
<td>282D X 282R-18</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Flushbolt (Bottom)</td>
<td>282D X 12</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Dust Proof Strike</td>
<td>280X</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Mortise Lockset</td>
<td>ML2067-NSR X CT6B</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cylinder Core</td>
<td>CR8000 X N6 KEYWAY</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Overhead Stop</td>
<td>906S (Active Leaf)</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Silencers</td>
<td>307D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HARDWARE GROUP 12
MARK: 138A
EACH TO HAVE:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Model/Style</th>
<th>Mark</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Hinges</td>
<td>FBB179-4.5X4.5</td>
<td>26D</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Flushbolt (Top)</td>
<td>282D X 282R-18</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Flushbolt (Bottom)</td>
<td>282D X 12</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Dust Proof Strike</td>
<td>280X</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Mortise Lock</td>
<td>ML2067-NSR X CT6B</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cylinder Core</td>
<td>CR8000 X N6 KEYWAY</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Closers</td>
<td>DC6210 X M54</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
<td>Mark</td>
<td>Quantity</td>
<td>Dimensions</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------</td>
<td>------</td>
<td>----------</td>
<td>---------------------</td>
</tr>
<tr>
<td>1</td>
<td>SEAL</td>
<td></td>
<td>1</td>
<td>5050 X 25’</td>
</tr>
<tr>
<td>2</td>
<td>DOOR BOTTOMS</td>
<td></td>
<td>2</td>
<td>335S X 36 W</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td></td>
<td>1</td>
<td>513 X ¼-20 MS/EA- 72”</td>
</tr>
<tr>
<td>2</td>
<td>JAMB PADS</td>
<td></td>
<td>2</td>
<td>60FP</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP 13**
MARK: 103A, 103B
EACH TO HAVE:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Mark</th>
<th>Quantity</th>
<th>Dimensions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGES</td>
<td></td>
<td>3</td>
<td>BB179-5 X 4.5</td>
<td>26D</td>
</tr>
<tr>
<td>1</td>
<td>MORTISE LOCK</td>
<td></td>
<td>1</td>
<td>ML2067-NSR X CT6B</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>CYLINDER CORE</td>
<td></td>
<td>1</td>
<td>CR8000 X N6 KEYWAY</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>CLOSER</td>
<td></td>
<td>1</td>
<td>DC6210 X M54</td>
<td>689</td>
</tr>
<tr>
<td>1</td>
<td>KICKPLATE</td>
<td></td>
<td>1</td>
<td>190S X B4E X CSK X 8”X34”</td>
<td>32D</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td></td>
<td>1</td>
<td>230W</td>
<td>626</td>
</tr>
<tr>
<td>3</td>
<td>SILENCERS</td>
<td></td>
<td>3</td>
<td>307D</td>
<td></td>
</tr>
</tbody>
</table>

**HARDWARE GROUP 14**
MARK: 114
EACH DOOR TO HAVE:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Mark</th>
<th>Quantity</th>
<th>Dimensions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGES</td>
<td></td>
<td>3</td>
<td>FBB179-4.5X4.5</td>
<td>26D</td>
</tr>
<tr>
<td>1</td>
<td>MORTISE LOCK</td>
<td></td>
<td>1</td>
<td>ML2067-NSR X CT6B</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>CYLINDER CORE</td>
<td></td>
<td>1</td>
<td>CR8000 X N6 KEYWAY</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td></td>
<td>1</td>
<td>230W</td>
<td>626</td>
</tr>
<tr>
<td>3</td>
<td>SILENCERS</td>
<td></td>
<td>3</td>
<td>307D</td>
<td></td>
</tr>
</tbody>
</table>

**HARDWARE GROUP 15**
MARK: 104
EACH DOOR TO HAVE:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Mark</th>
<th>Quantity</th>
<th>Dimensions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGES</td>
<td></td>
<td>3</td>
<td>FBB179-5 X4.5</td>
<td>26D</td>
</tr>
<tr>
<td>1</td>
<td>MORTISE CARD LOCK</td>
<td></td>
<td>1</td>
<td>CTMC30S4T</td>
<td>626</td>
</tr>
</tbody>
</table>

**DOOR HARDWARE**

08 71 00 - 25
## Door Hardware

**HARDWARE GROUP 16**  
**MARK: 106**  
**EACH DOOR TO HAVE:**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Model/Spec</th>
<th>Unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Hinges</td>
<td>FBB179-4.5X4.5</td>
<td>26D</td>
</tr>
<tr>
<td>2</td>
<td>Flushbolts</td>
<td>282D X 12</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Dustproof Strike</td>
<td>280X (INACTIVE LEAF)</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>SVR Exit Device</td>
<td>ED5470 X N955ET X H0706 X W048 X M54 X M55 X M110</td>
<td>630</td>
</tr>
<tr>
<td>1</td>
<td>Rim Cylinder</td>
<td>CR3080-178-6 PIN X CT6B X N6</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Closer</td>
<td>DC6210 X M54 (ACT LEAF)</td>
<td>689</td>
</tr>
<tr>
<td>1</td>
<td>Electromagnetic Holder</td>
<td>998M (ACTIVE LEAF)</td>
<td>689</td>
</tr>
<tr>
<td>2</td>
<td>Silencers</td>
<td>307D</td>
<td></td>
</tr>
</tbody>
</table>

**HARDWARE GROUP 17**  
**MARK: 118, 128**  
**EACH DOOR TO HAVE:**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Model/Spec</th>
<th>Unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Hinges</td>
<td>FBB179-4.5X4.5</td>
<td>26D</td>
</tr>
<tr>
<td>1</td>
<td>Flushbolt (Top)</td>
<td>282D X 282R-18</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Flushbolt (Bottom)</td>
<td>282D X 12</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Dust Proof Strike</td>
<td>280X</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Mortise Lockset</td>
<td>ML2067-NSR X CT6B</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Cylinder Core</td>
<td>CR8000 X N6 KEYWAY</td>
<td>626</td>
</tr>
<tr>
<td>2</td>
<td>Closers</td>
<td>DC6210 X M54</td>
<td>689</td>
</tr>
<tr>
<td>2</td>
<td>Silencers</td>
<td>307D</td>
<td></td>
</tr>
</tbody>
</table>

**Doors Hardware**  

08 71 00 - 26
HARDWARE GROUP 18
MARK: 137C
EACH DOOR TO HAVE

DOOR HARDWARE BY OVERHEAD SUPPLIER

HARDWARE GROUP 19
MARK: 138B
EACH DOOR TO HAVE

2 SEALS 601A X 6X3/4-TEK X 72” X 96” MILL
2 SWEEP (TOP & BOTTOM) 601A X 6X3/4-TEK X 72” MILL
1 BARN DOOR HARDWARE 200WF – 144

HARDWARE GROUP 20
MARK: 129A, 129B, 130A, 130B
EACH DOOR TO HAVE:

3 HINGES FBB179-4.5X4.5 26D
1 RIM EXIT DEVICE ED5202S X N955ET X CT6B X M54 X M110 630
1 RIM THUMB TURN CR3300 X 138 626
1 CYLINDER CORE CR8000 X N6 KEYWAY 626
1 CLOSER DC6210 X M54 689
1 KICKPLATE 190S X B4E X CSK X 8”X34” 32D
3 SILENCERS 307D

NOTE: THUMB TURN CYLINDER USED IN LIEU OF RIM CYLINDER ON INSIDE OF DOUBLE KEYED EXIT DEVICE.

HARDWARE GROUP 21
MARK: 139
EACH DOOR TO HAVE:

3 HINGES FBB179-4.5x4.5 26D
1 MORTISE LOCK ML2067-NSR X CT6B 626
1 CYLINDER CORE CR8000 X N6 KEYWAY 626

DOOR HARDWARE 08 71 00 - 27
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Code</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CLOSER</td>
<td>DC6210 X M54</td>
<td>628</td>
</tr>
<tr>
<td>1</td>
<td>KICKPLATE</td>
<td>190S X B4E X CSK X 8”X34”</td>
<td>32D</td>
</tr>
<tr>
<td>3</td>
<td>SILENCERS</td>
<td>307D</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION 08 71 00
SECTION 08 80 00 - 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.
B. Section 06 40 23 - Interior Architectural Woodwork
C. Section 08 11 13 - Hollow Metal Doors and Frames
D. Section 08 14 16 - Flush Wood Doors
E. Section 08 56 19 - Interior Sliding Pass Windows

1.2 SUMMARY

A. Section includes:
   1. Glass for windows, doors, and interior side-lites.
   2. Glazing sealants and accessories.
   3. Laminated glass.
   4. Display case glass doors and shelves

B. Related Requirements:
   1. Section 06 40 23 “Interior Architectural Woodwork” for display case glass doors, shelves, and hardware

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.
D. 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:
   1. Insulating glass for exterior windows, in final installation size.

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 Installer.

B. Product Certificates: For glass.

C. Product Test Reports: For insulating glass and glazing sealants, for tests performed by a qualified testing agency.
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

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.

B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

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.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.
1.9 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.

1.10 WARRANTY
A. 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: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:

1. AGC Glass Company North America, Inc.
2. Guardian Industries Corp.
3. Oldcastle Building Envelope.
4. Pilkington North America Inc.
5. 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 IBC and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.

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 monolithic-glass lites, properties are based on units with lites of thickness indicated.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. 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.
4. 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.
5. 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. GANA Publications: "Glazing Manual."

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.

D. Thickness: Provide glass that complies with performance requirements and is not less than the thickness indicated.
E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. 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.

2.5 LAMINATED GLASS

A. 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.

B. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
   1. Glass fabricated with one outer layer of 1/8 inch thick heat strengthened clear float glass and one inner layer of 1/8 inch thick, tempered clear float glass with polyvinyl butyral 0.060" interlayer.

C. Interlayer:
   1. Color: Clear unless otherwise indicated.
   2. Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

2.6 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 manufacturer's standard primary and secondary sealants.
   2. Desiccant: Molecular sieve or silica gel, or a blend of both.
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.

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. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. 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. Edge Finishing for display case doors and shelves: Finish edges smooth and polished, without chips, scratches, or warps.
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 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 Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.7 GLASS SCHEDULE

A. Glass Type GL-1: Clear fully tempered float glass.

1. Minimum Thickness: 1/4".
2. Safety glazing required.
B. Glass Type GL-2: Clear laminated glass.
   1. Basis-of-Design Product: Clear float glass with polyvinyl butyral interlayer, clear, 0.30-inches
   2. Minimum Thickness: 1/4".
   3. Safety glazing required.
   4. Location: for use in acoustic window frames

C. Glass Type GL-3: Clear tempered fire-rated glass.
   1. Minimum Thickness: 1/4".
   2. Safety glazing required.

D. Glass Type GL-4: Clear insulated glass.
   1. Basis-of-Design Product: Clear float glass with polyvinyl butyral interlayer, clear, 0.30-inches
   2. Overall Unit Thickness: 1 inch.
   4. Outside Lite: ¼" laminated glass.
   5. Interspace Content: Air.
   6. Indoor Lite: ¼" laminated glass.

END OF SECTION 08 80 00
SECTION 08 90 00 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

B. Related Sections:

1. Division 23 Sections for louvers that are a part of mechanical equipment.
2. Division 23 Section "Instrumentation and Control for HVAC" for electric, electronic, and pneumatic control of adjustable 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.

B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

D. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on a uniform pressure of 30 lbf/sq. ft., acting inward or outward.
B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

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, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified NC licensed professional engineer responsible for their preparation.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."


1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
4. For fastening stainless steel, use 300 series stainless-steel fasteners.
5. For color-finished louvers, use fasteners with heads that match color of louvers.

C. Post-installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. 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.

1. Frame Type: Exterior flange with subsill and head unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide subsills and head receptors made of same material as louvers for all louvers.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.
2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Continuous-Line, Drainable-Blade Louver: Drainable-blade louver with blade gutters (drains) in rear two-thirds of blades only and with semi-recessed mullions capable of collecting and draining water from blades.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Airolite Company, LLC (The).
   b. American Warming and Ventilating.
   c. Arrow United Industries; a division of Mestek, Inc.
   d. Construction Specialties, Inc.
   e. Greenheck Fan Corporation.
   f. Ruskin Company; Tomkins PLC (BASIS OF DESIGN ELF6375DX)

2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Louver Performance Ratings:
   a. Free Area: Not less than 6.02 sq. ft. for 72-inch-wide by 24-inch-high louver.
   b. Point of Beginning Water Penetration: COORDINATE WITH MECHANICAL DRAWINGS.
   c. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area intake velocity, COORDINATE WITH MECHANICAL DRAWINGS.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 3 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 kind 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.
2.5 BLANK-OFF PANELS
A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.
   1. Aluminum sheet for aluminum louvers, not less than 0.050-inchnominal thickness.
   2. Panel Finish: Same finish applied to louvers.

2.6 FINISHES, GENERAL
A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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.
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 and vents 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 weather tight 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. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weather tight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents 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 and vents 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 08 90 00
SECTION 09 22 16 - 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.
   B. Related Requirements:
      1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   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.

2.2 FRAMING SYSTEMS
   A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
   B. 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. Coatings with equivalent corrosion resistance are not acceptable.

C. **Studs and Runners: ASTM C 645**. Steel Studs and Tracks, or Embossed Steel Studs and Tracks, may be used.

1. **Steel Studs and Tracks:**
   a. Minimum Base-Metal Thickness: Unless otherwise noted on drawings, provide 0.033 inch (20 gauge).
   b. Depth: As indicated on Drawings.

2. **Embossed Steel Studs and Tracks:** Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally equivalent to conventional ASTM C 645 steel studs and tracks.
   a. Minimum Base-Metal Thickness: Unless otherwise noted on drawings, provide 0.0190 inch minimum (20 ga equivalent).
   b. Depth: As indicated on Drawings.

D. **Slip-Type Head Joints:** Where indicated, provide one of the following:

1. **Slotted 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.

E. **Flat Strap and Backing Plate:** Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.027 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: 0.033 inch.
2. Depth: As indicated on Drawings.

H. **Resilient Furring Channels:** 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical

I. **Z-Shaped Furring:** With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.
J. Multi-Directional Load Resistant Angle: B.O.D.: StiffClip
   1. ASTM A1003/A1003M Structural Grade 50 (340) Type H, ST50H (ST340H)
   2. Minimum yield strength: 50ksi
   3. Minimum tensile strength: 65ksi
   4. Minimum thickness: 14 gauge
   5. ASTM A653/A653M G90 (Z275) hot dipped galvanized coating.

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.
   B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
   C. 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: As indicated on Drawings.
   D. 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: 0.033 inch.
         b. Depth: As indicated on Drawings.
         a. Minimum Base-Metal Thickness: 0.033 inch

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 one of the following:
      1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. 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.
   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. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
   2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
   3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. 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.
      1) Install three studs at doors over 36” wide.
   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.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:
1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. 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 according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

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.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

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. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. 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.
G. 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 09 22 16
SECTION 09 29 00 - 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. This Section includes the following:

1. Interior gypsum board.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood framing and furring that supports gypsum board.
2. Division 07 Section "Thermal Insulation" for insulation installed in assemblies that incorporate gypsum board.
3. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
4. Division 09 Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.
5. Division 09 Section “Interior Painting” for primers applied to gypsum board surfaces.

1.3 QUALITY ASSURANCE

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.

1.4 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT 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 interior products 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 PANELS, GENERAL

A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of Insert number 36.5 percent by weight.

B. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. American Gypsum Co.
      b. BPB America Inc.
      c. G-P Gypsum.
      d. Lafarge North America Inc.
      e. National Gypsum Company.
      f. PABCO Gypsum.
      g. Temple.
      h. USG Corporation.

B. Type X:

   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
C. Impact-Resistant Type: ASTM C 1396 gypsum board, tested according to ASTM C 1629/C 1629M. Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.

2. Surface Abrasion: ASTM C 1629, meets or exceeds Level 1 requirements.
3. Indentation: ASTM C 1629, meets or exceeds Level 1 requirements.
4. Soft-Body Impact: ASTM C 1629, meets or exceeds Level 1 requirements.
7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
8. Location:
   a. Assembly Lab 138
   b. Machine Shop 140
   c. Student Lounge 125 & 126 at perimeter wall

D. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
4. Location: For use at wet walls in individual toilet rooms.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
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. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   e. Expansion (control) joint, with matching ‘T’ and ‘Cross’ Intersections.

B. Aluminum Reveals:

1. Material: Extruded Aluminum trim with factory spray and baked on primer to serve as the basis of field painting.
2. Shapes: Reveal molding as manufactured by Fry Reglet or approved equal, in sizes and profile as indicated on the drawings where indicated.
2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, 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.
5. Joint Compound for Exterior Applications:

2.5 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. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, 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. 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. Type X: As indicated on Drawings.
2. Abuse-Resistant Type: As indicated on Drawings.
3. Moisture- and Mold-Resistant Type: In all damp or wet locations including but not limited to toilet rooms, janitors closets, mechanical rooms, kitchens, food prep areas, areas with exterior walls below grade, etc.

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.
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 1 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. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
3.4 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 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.

   3. Expansion Control Joint: Use where indicated, and:
      a. In walls, use to separate gypsum panel sections into no more than 30 feet in any direction.
      b. In ceiling, use to separate gypsum panel sections into no more than 50 feet in any direction.


3.5 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 those with trim having flanges not intended for 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 4: 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.
3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. 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 09 29 00
SECTION 09 30 13 - 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 tile.
   2. Ceramic mosaic tile.
   5. Crack isolation membrane.
   6. Tile backing panels.
   7. Metal edge strips.

B. Related Sections:
   1. Division 09 Section "Gypsum Board"

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.


C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
1. Level Surfaces: Minimum .60.
2. Step Treads: Minimum .60.
3. Ramp Surfaces: Minimum .60.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. 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 4 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. Metal edge strips in 6-inch lengths.

C. Product Certificates: For each type of product, signed by product manufacturer.

D. Material Test Reports: For each tile-setting and grouting product.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one 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 one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
   1. Waterproof membrane.
   2. Crack isolation membrane.
   4. Cementitious backer units.
   5. Metal edge strips.

D. 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 each type of floor tile installation.
   2. Build mockup of each type of wall tile installation.
3. Approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

1.7 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.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT 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.

1.9 EXTRA MATERIALS

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.

PART 2 - PRODUCTS

2.1 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 unless otherwise indicated.
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 TCA 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.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. General: Basis of design has been utilized for the selection of these products. Additional manufacturers are acceptable subject to full compliance with these specifications including but not limited to color, finish, cut, thickness, etc. All tile shall come from a single manufacturer unless otherwise noted.

B. Tile Type T-1: Rectified Porcelain tile. – Wall and Floor:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville, Altered State Porcelain Stone Tile (Contact: Sheryl L. Haselton, 828.768.7200 shaselton@crossvillestudios.com) or comparable product by one of the following:

   a. Daltile
   b. Royal Mosa.
   c. Stonepeak.

2. Face Size 12 x 24 inches.
3. Tile Color AV341 White Hot
4. Pattern: 1/3 Running Bond
5. Grout Color: As selected by Architect from manufacturer's full range.
6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

   a. Cove Base (Designation PT-1):
   b. Cove Base 6 tall x 12 inches.
   c. At locations with wall tile, top bullnose edge of cove base must be cut off with a waterjet cutter or wet saw if it has a bullnose edge.
   d. Inside Corner Cove: 6" tall.
C. Tile Type T-2: Porcelain Wall tile:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville, Altered State Porcelain Stone Tile or comparable product by one of the following:
   a. Daltile
   b. Royal Mosa.
   c. Stonepeak.

2. Face Size: 2 x 12 inches.
3. Tile Color AV341 White Hot
4. Pattern: Vertical Stacked Bond
5. Grout Color: As selected by Architect from manufacturer's full range.

2.3 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 C 503/C 503M, with a minimum abrasion resistance of 12 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. C-Cure; C-Cure Board 990.
   b. Custom Building Products; Wonderboard.
   c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
   d. USG Corporation; DUROCK Cement Board.

2. Thickness: 5/8 inch.

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.

1. Products Subject to compliance with the requirements provide one of the following:
   a. Laticrete International, Inc; 9235 Waterproofing membrane - BASIS OF DESIGN.
   b. Mer Kote Products; Hydro Guard 2000.
   c. Bonsal American; B6000 Waterproofing Membrane with Glass Fabric.

2.6 SETTING MATERIALS


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Boiardi Products; a QEP company.
   b. Bonsal American; an Oldcastle company.
   c. Bostik, Inc.
   d. C-Cure.
   e. Custom Building Products.
   f. Jamo Inc.
   g. Laticrete International, Inc.
   h. MAPEI Corporation.
   i. Mer-Kote Products, Inc.
   j. Southern Grouts & Mortars, Inc.
   k. Summitville Tiles, Inc.
   l. TEC; a subsidiary of H. B. Fuller Company.

2. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive at Project site.

3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.


1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils thick.

2.7 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Boiardi Products; a QEP company.
   b. Bonsal American; an Oldcastle company.
c. Bostik, Inc.
d. C-Cure.
e. Custom Building Products.
f. Jamo Inc.
g. Laticrete International, Inc.
h. MAPEI Corporation.
i. Southern Grouts & Mortars, Inc.
j. Summitville Tiles, Inc.
k. TEC; a subsidiary of H. B. Fuller Company.

2. Polymer Type: Acrylic resin in liquid-latex form for addition to prepackaged dry-grout mix.

2.8 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. DAP Inc.; 100 percent Silicone Kitchen and Bath Sealant.
   b. Dow Corning Corporation; Dow Corning 786.
   c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
   e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
   f. Tremco Incorporated; Tremsil 600 White.

2.9 MISCELLANEOUS MATERIALS

A. Metal Edge Strips: Angle or L-shape, height to match tile and profile as indicated on the drawings and setting-bed thickness, Basis of design is Schluter SCHIENE-AE anodized aluminum and Schluter RENO-RAMP anodized aluminum.
B. 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.

C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.10 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 installed tile.

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 thin-set 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 thin-set 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 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA 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 TCA 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. 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. 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.

E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
2. Unglazed floor tile: 1/8 inch.

F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

G. 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.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

H. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.4 TILE BACKING PANEL INSTALLATION

A. Install cementitious backer units 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 and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.6 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-Portland cement grout residue from tile as soon as possible.
2. 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. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
B. 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.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

NOTE: INTERIOR TILE SCHEDULE FOLLOWS THIS PAGE
INTERIOR TILE INSTALLATION SCHEDULE

Interior Floor Installations, Concrete Subfloor:

1. Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.-IN ALL TOILET AND BATHROOMS. SEE ITEM C BELOW FOR SHOWER INSTALLATION REQUIREMENTS.
   b. Grout: Polymer-modified sanded grout.

Interior Wall Installations, Metal Studs or Furring:

2. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA W244.
   b. Grout: Polymer-modified sanded grout.

END OF SECTION 09 30 13
SECTION 09 51 23 - ACOUSTICAL TILE 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:
      1. Acoustical tiles for ceilings.
      2. Concealed suspension systems.
   B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For testing agency.
   B. Product Test Reports: For each acoustical tile ceiling, for tests performed by a qualified testing agency.
   C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
      1. Ceiling suspension-system members.
      2. Structural members to which suspension systems will be attached.
      3. Method of attaching hangers to building structure.
         a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
   a. Lighting fixtures.
   b. Diffusers.
   c. Grilles.
   d. Speakers.
   e. Sprinklers.
   f. Access panels.
   g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.

1.6 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
      2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE
   A. Testing Agency Qualifications: Qualified according to the National Voluntary Laboratory Accreditation Program (NVLAP) for testing indicated.
   B. 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 ceiling area as shown on Drawings.
      2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. 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: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 450 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL TILES, GENERAL

A. Low-Emitting Materials: Acoustical tile ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Source Limitations:
1. Acoustical Ceiling Tile: Obtain each type from single source from single manufacturer.
2. Suspension System: Obtain each type from single source from single manufacturer.

C. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system from single source from single manufacturer.

D. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 30 percent.

E. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

F. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACoustical TILES ACT-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide: Optima Fineline Tegular, as manufactured by Armstrong World Industries, Inc., or a comparable product by one of the following:

1. USG Interiors, Inc.
2. BPB USA.

B. Classification: Provide tiles complying with ASTM E 1264 for type, form, and pattern as follows:

1. Pattern: As indicated by manufacturer's designation.

C. Color: White.

D. LR: Not less than 0.90.

E. NRC: Not less than 0.95.

F. CAC: Not less than 35.

G. Articulation Class (AC): Not less than 190.
H. Fire Performance: Class A

I. Edge/Joint Detail: Beveled Tegular for interface with Suprafine XL 9/16" Exposed Tee (Basis of Design).

J. Thickness: 15/16 inch.

K. Modular Size: 2'x2'

L. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Metal Suspension-System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

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:


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.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.
H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical tiles in-place.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.


2.6 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:
   a. Henkel Corporation; OSI Sealants Pro-Series SC-175 Rubber Base Sound Sealant.
   b. Pecora Corporation; AIS-919.

B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 MISCELLANEOUS MATERIALS

A. Acoustical Tile Adhesive: Type recommended by acoustical tile manufacturer, bearing UL label for Class 0-25 flame spread.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
B. staples: 5/16-inch-long, divergent-point staples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Testing Substrates: Before installing adhesively applied tiles on wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

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. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard
suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. 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.

6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

8. Do not attach hangers to steel deck tabs.

9. Do not attach hangers to steel roof deck. Attach hangers to structural members.

10. 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.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

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 post-installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles.

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, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. 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. Arrange directionally patterned acoustical tiles as follows:

1. As indicated on reflected ceiling plans.

G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.
1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.

3.4 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 23
SECTION 09 51 24 – OPEN LINEAR WOOD CEILING AND WALL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Section 09 51 23 - Acoustical Tile Ceilings for suspension systems
C. Section 21 13 13 - Wet-Pipe Sprinkler Systems
D. Section 26 51 19 - LED Interior Lighting

1.2 SUMMARY

A. This Section includes the following: Natural wood ceiling and wall systems

1.3 DESIGN / PERFORMANCE REQUIREMENTS

A. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:360.
B. Wood is a natural product that will undergo changes with variations in the environment. Therefore, all dimensional tolerances are plus or minus 1/8 inch (3 mm).
C. Seismic Suspended wood ceilings meet seismic code compliance via direct screw attachment to heavy duty grid. Local code requirements should be consulted in order to determine additional requirements.
D. Fire Performance Characteristics: Suspended wood ceilings shall conform to Class 1, or A flame spread rating, tested according to ASTM E 84; Flame Spread: 25 or less. Smoke Developed: 450 or less.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
B. Shop Drawings: Provide layout of suspended wood ceiling and T-rails coordinated with other trades that will penetrate the wood ceiling or interfere with the installation and recessed or surface mounted devices located within the ceiling panels. Indicate method of suspension where interference exists. Provide reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
1. Method of attaching door frames to surrounding construction.
2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, sprinklers, and special trim.

C. Selection Samples: For each finish product specified, two complete sets of color brochures representing the manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 12 inches (305 mm) square, representing actual product, color, and patterns.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment and periodic cleaning and maintenance of all components.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain through one source from a single manufacturer.

B. Installer Qualifications: Minimum 2 years documented experience installing projects of similar size and complexity.

C. Provide seismic design of suspended ceiling under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

D. In-Place Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.
   4. Accepted mock-ups shall be comparison standard for remaining Work

E. Pre-Installation Conference: Convene minimum two weeks prior to starting work of this section. Agenda shall include project conditions, coordination with work of other trades, and layout of items that penetrate ceilings.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Plenums have proper ventilation, especially in high moisture areas with no excessive buildup of heat in the ceiling areas.

C. Space shall be fully enclosed with all exterior windows and doors in place, glazed, and weather-stripped. Roof is to be watertight, and all wet trades' work is to be completed, and thoroughly dry.
D. Mechanical, electrical, and other utility services above the ceiling plane shall be completed. No materials should rest against, or wrap around, the ceiling suspension components or connecting hangers.

E. Install only when the temperature and humidity closely approximate the interior conditions that will exist when the building is occupied. Heating and cooling systems shall be operating before, during, and after installation, with the humidity of the interior spaces maintained between 25 and 55 percent, and a temperature between 60 to 90 degrees F.

1.7 COORDINATION

A. Coordinate layout and installation of the wood slats ceiling systems with other work penetrating the ceiling including light fixtures, HVAC equipment, and fire suppression system components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:


2. Armstrong World Industries

3. USG Interiors, Inc.

2.2 MATERIALS

A. General: Standard Panel Grilles to be 1-foot wide and in nominal lengths of 2-feet to 10-feet in 1-foot increments. Actual lengths to be 1-inch shorter to allow for a reveal between panels. Wood strips to be fabricated without finger-joints, and fastened together with black dowels or wood backers, depending on panel design.

B. Ceiling Panels:
   a. Size:
      1. **Number of Blades per foot**: 6
      2. **Space between Blades**: 1 ¼”
      3. **Blade Thickness**: ¾”
      4. **Depth of the Blades**: 2”
      5. **Wood Species**: Ash
      6. **Finish**: Satin Clear
   b. Doweled Panel Grilles Design Description:
      1. Grilles to consist of individual wood strips assembled in 12-inch widths in lengths up to 10-feet. Wood strips to be drilled 12-inches on center, beginning 5-1/2 inch from each end with interconnecting male-to-female dowel attachment. Dowels to be positioned perpendicular to the wood strips. Panel Grilles to be 1 inch under an even
foot length. Dowels to be furnished black to be hidden from view. Dowel clips to be used to snap the Panel Grilles into place. Provide fabric scrim at top of grille in standard black color.

C. Wall Panels:
   a. Size:
      1. Number of Blades per foot: 6
      2. Space between Blades: 1 ¼”
      3. Blade Thickness: ¾”
      4. Depth of the Blades: 1 3/8”
      5. Wood Species: Ash
      6. Finish: Satin Clear
   b. Panel Grilles Design Description:
      1. Grilles to consist of individual wood strips assembled in 12-inch widths in lengths as shown on drawings. Wood backers to be positioned perpendicular to the wood strips and attached to the back of grilles 12 inches on center, beginning 3 inches from each end and evenly spaced as shown on drawings. Wood backers are furnished in color as selected by Architect to match wall behind so as to be hidden from view.

2.3 ACCESSORIES

A. Hangers: Suspension hangers that are direct-screwed to the panel and hang over the heavy duty-grid. Hangers are made of spring-steel with phosphate pre-treatment and corrosion-resistant coating

D. Torsion Springs and Saddle Clips: Two parts of a suspension system in which the torsion spring is direct-screwed to the panel and compressed to attach to the saddle clip that is fitted over the heavy duty-grid. Springs and clips are made of spring-steel with phosphate pre-treatment and corrosion-resistant coating.

E. Dowel Clips: Clips are spring-steel with phosphate pre-treatment and corrosion-resistant coating and are attached by fitting around the dowel and attaching to the grid system.

F. Integrated Lighting: Coordinate ceiling panels with specified lighting.

G. Access Panels: Provide (4) field coordinated and cut as needed for above ceiling access.

2.4 SUSPENSION SYSTEMS

A. Main Tees: Standard heavy duty 15/16 inch (24 mm) T-rail specified in Section 09 22 26 - Suspension Systems.

B. Hangers: shall be Suspend ceiling panels from T-rail using torsion springs, C-hangers, or direct screw attachment, as recommended by the manufacturer.
2.5 FABRICATION

A. Edges, borders, and perimeter trims shall be indicated on the Drawings in accordance with the manufacturer's standard design details. All suspended wood ceiling products specified shall be supplied by the wood slat ceiling manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify that T-rail carriers specified in Section 09 22 26 - Suspension Systems are in place, suspended and leveled in a direction perpendicular to the wooden strip direction of the wood panels.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Work shall not begin until the space is fully enclosed and glazed and all wet work is completed and dried out to the satisfaction manufacturer.

C. Temperature shall be at least 65 degrees Fahrenheit during the installation and thereafter.

D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction, including the following:

1. Comply with ASTM C 636 and seismic design requirements indicated.

2. 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.

3. Additional Hanger Wires: Wrapped tightly 3 full turns to structure and component at locations where imposed loads could cause deflection exceeding 1/360 span or tolerances specified below.

B. Use a laser leveling device to lay out and install the perimeter trim as specified.

C. Suspend panels from the T-rail carrier system as indicated.

D. Make final adjustments to level or contours as required.

3.4 FIELD QUALITY CONTROL

A. Technical Service: Manufacturer shall provide a local Technical Service Representative for on-site training and assistance during the installation process.
B. Environmental Monitoring: Manufacturer shall provide a temperature and humidity sensor to actively monitor the room in which the wood slats shall be installed for a minimum of one week before and up to two weeks after installation has been completed including all of the weeks in between.

C. Upon completion of ceiling installation, the owner's representative shall inspect all finished surfaces to ensure that the work has been completed in a manner satisfactory to the owner. Any deficiencies in the install of the ceiling shall be corrected prior to substantial completion.

3.5 ADJUSTMENTS AND CLEANING

A. Clean exposed surfaces of ceiling panel in accordance with manufacturer's instructions.

B. Remove and replace panels and tiles, which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 09 51 24
SECTION 09 65 13 - 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.
B. Section 018114 High Performance Building Requirements (HPBr)

1.2 SUMMARY

A. Section Includes:
   1. Resilient base.
   2. Resilient molding accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

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 PROJECT 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. Until Final Acceptance, maintain ambient temperatures within range recommended by 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.

1.7 EXTRA MATERIALS

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.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE

A. Manufacturers: Basis of Design: Roppe Pinnacle TS Rubber Wall Base or subject to compliance with requirements, provide products by one of the following:

1. AB; American Biltrite.
2. Allstate Rubber Corp.
3. Armstrong World Industries, Inc.
4. Burke Mercer Flooring Products, Division of Burke Industries Inc.
5. Flexco.
8. Nora Systems, Inc.
9. VPI, LLC, Floor Products Division.

B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).

2. Style and Location:
   a. Style B, Cove.

C. Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.
F. Outside Corners: Job formed or preformed.
G. Inside Corners: Job formed or preformed.
H. Colors: 175 Slate

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated. Utilize low VOC less than 250g/L.

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.

B. 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.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

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 as long as practicable 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 at inside and outside 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 carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of 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 surfaces thoroughly.
   3. Damp-mop 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 until Final Acceptance.

END OF SECTION 09 65 13
SECTION 09 65 19 - 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.
B. Section 018114 High Performance Building Requirements (HPBr)

1.2 SUMMARY

A. Section Includes:
   1. Luxury Vinyl Tile
   2. Rubber Tile Flooring
   3. ESD Rubber Flooring

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   3. Product Data: For chemical-bonding compounds, indicating VOC content.
   4. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
   5. Product Data: For sealants, indicating VOC content.
   6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
   7. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
   8. Environmental Product Declaration: For each product.
   9. Health Product Declaration: For each product.
   10. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   1. Show details of special patterns.
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.

F. Product Schedule: For resilient products. Use same designations indicated on Drawings.

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: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

   1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. Installer Qualifications for Resilient Linoleum: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

   1. Must be a Manufacturer’s Certified Installer.
   2. Proof of valid certification must be submitted to the GC and verified by Manufacturer prior to the start of the project.
   3. The Manufacturer’s Certified Installer must manage and be on site during installation at all times.

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 mockups for floor tile including resilient base and accessories.

      a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
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 Final Project Acceptance.

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 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. 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 55 deg F or more than 85 deg F.

B. Maintain ambient temperatures within range recommended by manufacturer, but not less than 68 deg F or more than 85 deg F in spaces to receive resilient products during the following time periods:

1. Seven days before installation.
2. During installation.
3. Seven days after installation.

C. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

D. Fill cracks, holes, depressions and irregularities in the substrate with good quality Portland cement based underlayment leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

E. Maintain the ambient relative humidity between 40% and 60% during installation.

F. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 85 deg F.

G. Close spaces to traffic during resilient flooring installation.

H. Close spaces to traffic for 48 hours after resilient flooring installation.

I. Install resilient products after other finishing operations, including painting, have been completed.
1.10 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1. Warranty Period: Fifteen (15) year limited warranty commencing on Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore certification.

A. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Static Load Limit: (ASTM F970) 1500 psi

C. Flexibility: (ASTM F137) Passes

D. Resistance to Heat: (ASTM F1514) Passes

E. Resistance to Light: (ASTM F1515) Passes

F. Radiant Flux: (ASTM E648) Class I

G. Smoke Density: (ASTM E 662) ≤ 450

H. Size & Squareness: (ASTM F2055) Passes, +/- 0.016 in. per linear foot

I. Thickness: (ASTM F386) Passes

J. Dimensional Stability: (ASTM F2199) Passes

K. Residual Indentation: (ASTM F1914) Passes

L. Resistance to Chemicals: (ASTM F925) Passes
2.2 SOLID VINYL FLOOR TILE (LVT-1, LVT-2, and LVT-3)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Drawn Lines by Interface., or comparable product by one of the following:

1. Forbo
2. Milliken

B. Tile Standard: ASTM F1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: A, Smooth Surface

C. Thickness: 4.5 mm.

D. Wear Layer: 22 mil.

E. Size: 25cm x 1m inches.

A. Colors and Patterns:
1. LVT-1: A00910 Opal
2. LVT-2: A00902 Topaz
3. LVT-3: A00907 Onyx

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Cementitious formulation recommended by floor covering manufacturer for applications indicated, with minimum compressive strength of 3,500 psi. (ACI 302.2R-06 Ch. 9.5)

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Metal trim and accessories: Stainless steel transition strips of sufficient size to protect exposed edge of floor coverings and base. Install at locations where LVT transitions to thinner or thicker material.

2.4 RUBBER FLOOR TILE (RUB-1)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Norament XP by Nora, or comparable product by one of the following:
1. Forbo
2. Patcraft

   1. Type: 1B and Grade 1, Smooth Surface

C. Rubber Floor Tile:
   1. Limited Wear Warranty: 10 years
   2. Material: Vulcanized rubber with environmentally compatible color pigments that are free of toxic heavy metals like lead, cadmium or mercury
   3. Composition: Homogeneous
   4. Color: Orion
   5. Surface: Hammered
   6. Back of Tile: Double-sanded smooth
   8. Squareness (ASTM F2055): Meets requirements
   9. Thickness (ASTM F386): 0.14 inches (3.5mm)
   10. Dimensional Stability (ASTM F2199): Meets requirements
   11. Flammability (E648/NFPA 253): NBSIR 75 950, 0.71
   12. Smoke Density (ASTM E662/NFPA 258): NBS, 423 (flaming) and 290 (non-flaming)
   13. CAN/ULC-S102.2: Surface Burning, FSC1 of 55 and SD of 450
   14. Burn Resistance: Resistant to cigarette and solder burns
   15. Slip Resistance (ASTM D2047): Static coefficient of friction, Neolite dry 0.90 Neolite wet 1.0
   17. VOC’s: GREENGUARD Gold Certified for Low VOC Emissions and CA 01350 compliant
   18. Latex Allergies (ASTM D6499): Inhibition Elisa, results to be below detection level
   19. Sound Absorption (ASTM E2179): Δ IIC 15 (compare only Δ values)
      ≤ 0.005 inches with 250 lbs. is required
   22. Rolling Load Limit: ≤ 850 lbs. / sq. inch; for fork lift traffic nora® polyurethane adhesive is required
   23. Abrasion Resistance (ASTM D3389): 1.1 lbs. (500g) load on H-18 wheel with 1000 cycles, 0.005 oz. (0.13g) weight loss
      ≤ 0.035 oz. (1.0g) is required
   24. Oil & Grease Resistance: No
25. Heat Resistance (ASTM F1514): Easily achieved with all batches and regular maintenance
    Avg. ∆E ≤ 8.0 is required
27. Substrate Preparation: Per ASTM F710

2.5 ESD RUBBER FLOOR TILE (RUB-2)

A. Basis-of-Design Product: Subject to compliance with requirements, provide EC Rubber Tile Flooring by Staticworx, Inc., or comparable product by one of the following:

1. Roppe
2. Flexco

B. Rubber Tile for ESD Protection Control:

1. Static conductive per ANSI/ESD S7.1-2013, smooth surface, vulcanized two-layer construction,
2. Overall thickness: 2.0 mm
3. Tile size: 24 inches by 24 inches.
4. Material: Rubber with abundant natural fillers and environmentally compatible color pigments. Rubber content: >30%.
5. Color: 6105 Largo
7. Limited Wear Warranty/Conductivity Warranty: 10-year wear; Lifetime conductivity.
8. Standard: ASTM F 1344, for through-mottled tiles as applicable.
11. Slip Resistance: Static coefficient of friction (James Test): ASTM D 2047, equal to or greater than 0.6, ADA guidelines compliance.
13. Flammability: ASTM E 648; NFPA 253; NBSIR 75 950 result to be not less than 0.45 watts per square centimeter, Class 1.


17. PVC-Free: Products shall contain no poly-vinyl-chloride.

18. Conductivity: \( \leq 1.0 \times 10^6 \) resistance to ground when tested according to ASTM F 150/ESD.S7.1-2013 under >30% relative humidity at room temperature.

19. Decay Time: <.025 seconds when tested according to FTM4046 101.

20. Static Generation: <20 volts when tested according to ESDSTM 97.2.


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 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 floor tile manufacturer. Do not use solvents.

3. Mechanically remove contamination on the substrate that may cause damage to the resilient flooring material. Permanent and non-permanent markers, pens, crayons, paint, etc., must not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written requirements.
   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 or as required by manufacturer’s written recommendations, whichever is more restrictive.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum percent relative humidity level required by manufacturer’s written requirements.
   c. A pH test for alkalinity must be conducted. If the test results are not within the acceptable range of manufacturer’s written requirements, the installation must not proceed until the problem has been corrected.
   d. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.

5. The following standards apply:
   a. ASTM E 1745-97 – Standard Specification for Water Vapor Retarders
   b. ASTM E 1643 – Standard Practice for Installation of Water Vapor Retarders used in contact with Earth or Granular Fill Under Concrete Slabs
   c. ASTM E 96-00 – Standard Test Method for Water Vapor Transmission of Materials
   d. ACI 302.1R-04 – Guide for Floor and Concrete Slab Construction
   e. ACI 302.2R-06 – Guide for Concrete Slabs That Receive Moisture-Sensitive Flooring Materials
   f. ASTM F710-08 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
   g. ASTM F 1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

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. Use only cementitious patching and filling compounds (3000 PSI). Consult manufacturer for details. (ACI 302.2R-06 ch. 9.5)

D. Do not install floor tiles until they are the same temperature as the 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.

F. Assure that the levelness (FL 15), and flatness (FF 20 5/16 in 10 Ft.) of surface is in compliance with manufacturer’s guidelines.
3.3 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 sheets square with room axis.
3. Arrange for a minimum number of seams and place them in inconspicuous and low traffic areas, but in no case, less than 12 inches away from parallel joints in flooring substrates.

C. Match floor sheets for color and pattern by selecting sheets from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Match edges of floor coverings for color shading and pattern at seams

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 finished floor 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 flooring 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 exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. No traffic for 24 hours after installation.
4. Do not wash floor until after period of time recommended by floor covering manufacturer.
5. Clean surfaces to remove marks and soil.
6. A regular maintenance program must be started after the initial cleaning.

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.
   1. Cover floor coverings with un-dyed, untreated building paper until inspection.
   2. Do not move heavy and sharp objects directly over floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.

D. Floor Polish for Vinyl Composition Tile: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
   1. **Apply three (3) coat(s).**

E. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 09 68 13 - 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.
   B. Modular walk-off carpet tile

1.3 Related Requirements:

1. Section 09 65 13 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile
2. Section 01 81 14 High Performance Building Requirements (HPBr)

1.4 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 installation recommendations for each type of substrate.

B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Show the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
   2. Carpet tile type, color, and dye lot.
   3. Type of subfloor.
   4. Type of installation.
   5. Pattern of installation.
   6. Pattern type, location, and direction.
   7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS
A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

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 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.

1.8 QUALITY ASSURANCE
A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Comply with CRI 104.

1.10 FIELD CONDITIONS
A. Comply with CRI 104 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 occupancy levels 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 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.

1.11 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, more than 10 percent edge raveling, snags, runs, dimensional stability, loss of tuft bind strength, loss of face fiber, delamination, pattern loss.


1.12 PERFORMANCE REQUIREMENTS

A. Substrate Conditions: All carpet and/or adhesive products must be able to be installed on subfloors with an in-situ relative humidity reading of up to 95% as determined per latest version of ASTM F2170.

B. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 2 - PRODUCTS

2.1 CARPET TILE – CPT-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide Plain Stitch by Interface, or comparable product by one of the following:

1. Milliken

B. Collection: Visual Code

C. Style #: 13925OAK00
D. Color: 105919 Flint Plain
E. Installation: Ashlar
F. Size: 25cm x 1m
G. Pile Construction: Tufted Pattern Loop
H. Standard Backing: GlasBac Tile
I. Yarn System: 100% Recycled Content Type 6 Nylon
J. Color System: 100% Solution Dyed
K. Construction: Tufted Pattern Loop
L. Pile Thickness: 2.0mm
M. Pile Density: 7,846
N. Total Recycled Content: > 70%
O. Antimicrobial Treatment: (AATCC 138 Washed) (AATCC 174 hParts 2&3)
P. Indoor Air Quality: Green Label Plus Certified

2.2 CARPET TILE – CPT-2
A. Basis-of-Design Product: Subject to compliance with requirements, provide Tuxedo Pocket by Flor, An Interface Company or comparable product by one of the following:
   1. Interface
   3. Milliken.
B. Product #: 21-1451
C. ITEM #: 21-1451-09
D. Color: Indigo / Gold
E. Installation: Monolithic
F. Size: 50cm x 50cm
G. Standard Backing: GlasBac Tile
H. Fiber Content: Nylon Type 6,6
I. Construction: Loop Pile
J. Fiber Content: Nylon
K. Dye Method: 100% Solution Dye.
L. Tufted Yarn Weight: 28 oz/yd2
M. Pile Height: .17 in for finished carpet tile.
N. Nominal total thickness: .310”.
O. Total Recycled Content: > 70%
P. Antimicrobial Treatment: (AATCC 138 Washed) (AATCC 174 hParts 2&3)
Q. Indoor Air Quality: Green Label Plus Certified

2.3 MODULAR WALK-OFF CARPET TILE – CPT-4

A. Basis-of-Design Product: Subject to compliance with requirements, provide Step Repeat-SR799 by Interface, or comparable product by one of the following:
   2. Milliken.
B. Product #: 1388502500
C. Color: 104935 Granite
D. Installation: Monolithic
E. Size: 50cm x 50cm
F. Yarn System: 100% Recycled Content Nylon
G. Color System: 100% Solution Dyed
H. Construction: Tufted Textured Loop
I. Antimicrobial Treatment: (AATCC 138 Washed) (AATCC 174 hParts 2&3)
J. Pile Thickness: 3.7mm
K. Pile Density: 6,612
L. Total Recycled Content: >65%
M. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program
2.4 INSTALLATION SCHEDULE

A. Refer to drawings for locations.

2.5 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Adhesives, if used, shall allow installation on sub floors with an in-situ relative humidity reading of up to 95% as determined per latest version of ASTM F2170.

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. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Any of the following methods may be used, as long as installation meets the relative humidity requirements of section 1.12 and other requirements of this section:

1. Partial glue down; install adhesive squares at corners of each tile.
2. Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
3. Tiles with dry adhesive coating integral to tile.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.

B. Protect installed carpet tile to comply with CRI 104, Section 16, “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 09 68 13
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished gypsum wallboard.
   1. Aluminum trim.

1.2 RELATED SECTIONS
A. Section 018114 High Performance Building Requirements (HPBr)
B. Section 09 22 16 - Non-Structural Metal Framing
C. Section 09 29 00 - Gypsum Board.
D. Section 09 65 13 - Resilient Base and Accessories

1.3 REFERENCES
A. American Society for Testing and Materials: Standard Specifications (ASTM)
   1. ASTM D 256 - Izod Impact Strengths (ft #/in)
   2. ASTM D 570 - Water Absorption (%)
   3. ASTM D 638 - Tensile Strengths (psi) & Tensile Modulus (psi)
   4. ASTM D 790 - Flexural Strengths (psi) & Flexural Modulus (psi)
   5. ASTM D 2583- Barcol Hardness

1.4 SUBMITTALS
A. Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.
C. Selection Samples: Submit manufacturer’s standard color pattern selection samples representing manufacturer's full range of available colors and patterns.

D. Samples for Verification: Submit appropriate section of panel for each finish selected indicating the color, texture, and pattern required.
1. Submit complete with specified applied finish.
2. For selected patterns show complete pattern repeat.
3. Exposed Molding and Trim: Provide samples of each type, finish, and color.

E. Manufacturers Material Safety Data Sheets (MSDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site.

1.5 QUALITY ASSURANCE

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
   a. Wall Required Rating – Class C.

B. Sanitary Standards: System components and finishes to comply with:
1. United States Department of Agriculture (USDA) / Food Safety & Inspection Services (FSIS) requirements for food preparation facilities, incidental contact.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials factory packaged on strong pallets.

B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (range of 60 to 75°F) for 48 hours prior to installation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work.

B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.8 WARRANTY

A. Furnish one-year guarantee against defects in material and workmanship.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide: FRP Panels, as manufactured by Marlite, or a comparable product by one of the following:

1. Panolam
2. Crane Composites

B. Product:
1. Standard FRP

2.2 PANELS

A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
1. Dimensions:
   a. Thickness – 0.090” (2.29mm) nominal
   b. Width - 4'-0” (1.22m) nominal
   c. Length – 8’-0” (2.4m) as indicated on the drawings
2. Tolerance:
   a. Length and Width: +/-1/8” (3.175mm)
   b. Square - Not to exceed 1/8” for 8 foot (2.4m) panels or 5/32” (3.96mm) for 10 foot (2.4m) panels

B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
1. Flexural Strength - 1.7 x 10^4 psi per ASTM D 790.
2. Flexural Modulus – 6.0 x 10^5 psi per ASTM D 790.
3. Tensile Strength – 8.0 x 10^3 psi per ASTM D 638.
4. Tensile Modulus – 9.43 x 10^5 psi per ASTM D 638.
5. Water Absorption - 0.17% per ASTM D 570.
6. Barcol Hardness (scratch resistance) of 30 as per ASTM D 2583.
7. Izod Impact Strength of 7.0 ft. lbs./in ASTM D 256

C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.

D. Front Finish: Smooth
1. Color: As chosen by Architect from Manufacturer’s full range
   a. Surface: Smooth
   b. Fire Rating Class C.
   c. Size: 48” x 96” x .090” nom.
2.3 BASE

A. Base Molding for 0.090” thick FRP Panels
   1. Color: Black
   2. Profiles:
      a. FRP Base Molding, 10’ length
      b. Inside Corner
      c. LH End Cap
      d. RH End Cap

2.4 MOLDINGS

A. Aluminum Anodized Trim: Heavy weight extruded aluminum 6063-T5 alloy prefinished at the factory.
   1. Profiles:
      a. Inside Corner, 8’ length
      b. Division, 8’ length
      c. Edge, 8’ length
      d. Color: Brite Satin Anodized

2.5 ACCESSORIES

A. Fasteners: Non-staining nylon drive rivets.
   1. Match panel colors.
   2. Length to suit project conditions.

B. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
   1. FRP Adhesive - Water-resistant, non-flammable adhesive.
   2. C-915 Construction Adhesive - Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
   3. Titebond Advanced Polymer Panel Adhesive – VOC compliant, non-flammable, environmentally safe adhesive.

C. Sealant:
   1. MS-250 Clear Silicone Sealant.
   2. MS-251 White Silicone Sealant.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
   1. Verify that stud spacing does not exceed 24” (61cm) on-center.
B. Repair defects prior to installation.
   1. Level wall surfaces to panel manufacturer’s requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

A. Comply with manufacturer's recommended procedures and installation sequence.

B. Cut sheets to meet supports allowing 1/8” (3 mm) clearance for every 8 foot (2.4m) of panel.
   1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
   2. Pre-drill fastener holes 1/8” (3mm) oversize with high speed drill bit.
      a. Space at 8” (200mm) maximum on center at perimeter, approximately 1” from panel edge.
      b. Space at in field in rows 16’ (40.64cm) on center, with fasteners spaced at 12” (30.48 cm) maximum on center.

C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
   1. Install panels with manufacturer's recommended gap for panel field and corner joints.
      a. Adhesive trowel and application method to conform to adhesive manufacturer’s recommendations.
      b. Drive fasteners for snug fit. Do not over-tighten.

D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
   1. All moldings must provide for a minimum 1/8 “(3mm) of panel expansion at joints and edges, to insure proper installation.
   2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.

B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.
SECTION 09 84 34 – CEMENTITIOUS WOOD FIBER ACOUSTIC PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cementitious wood fiber plank acoustical wall panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for acoustical wall panels, including plans, elevations, sections, details, and attachments to other Work.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates and test reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain acoustical wall panels from single source from single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Spread Index: 0.
2. Smoke-Developed Index: 0.

C. Mockups: Build an in-place mockup to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.

1. Include intersection of four wall panels, corners, and wood perimeters.
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.
PART 2 - PRODUCTS

2.1 WOOD FIBER ACOUSTICAL WALL PANELS

A. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. Tectum Finale Wall Panel System; Tectum Inc. Basis of Design
2. AcoustiPlank; Martin Acoustical Products, division of Martin Fireproofing GA., Inc.

B. Panels composed of wood fibers, bonded with an inorganic hydraulic cement binder, and formed in a continuous process under heat and pressure.

1. Edges: Beveled.
2. Panel Thickness: 2-inches.
3. Panel Height: As indicated on the drawings.
4. Panel Width: As indicated on the drawings.
5. Finish: Factory-painted, custom color as selected by Architect.

C. Screws for attaching panels: Painted head screws as recommended by the panel manufacturer.

D. Sound-Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficient of 0.95, as determined by testing per ASTM C 423 for mounting type specified.

E. Mounting Style: C-40, according to ASTM E 795.

F. Sound Insulation: 2-1/2-inches fiberglass blanket insulation compressed into the cavity space.

1. Minimum density of 0.75 lb/cu. ft.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Anchor panels securely to supporting substrate. Screw heads to be flush with panel surface.

C. Installation Tolerances: As follows:

1. Variation from Level and Plumb: Plus or minus 1/16 inch.
2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

D. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 09 84 34
SECTION 09 91 23 - 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. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Brick masonry units
3. Steel.
5. Wood.
7. Plaster.

B. Related Sections include the following:

1. Section 018114 High Performance Building Requirements (HPBr)

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. 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.

D. Project paint information schedule

1.4 QUALITY ASSURANCE

A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

B. Mockups: Apply benchmark samples 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 specified in Part 3.
   a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
   b. Other Items: Architect will designate items or areas required.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
   a. If preliminary color selections are not approved, apply additional benchmark samples of additional 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 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 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 an additional 5 percent, but not less than 1 gal. of each material and color applied.
2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide one of the following:
   1. Sherwin-Williams Company (The) (Basis of Design)
   2. Benjamin Moore & Co.
   3. Dulux.
   4. Duron, Inc.
   5. Envirocoat Technologies Inc.
   6. PPG Architectural Finishes, Inc.

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 of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
   1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
   2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
   3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
   4. Floor Coatings: VOC not more than 100 g/L.
   5. Shellacs, Clear: VOC not more than 730 g/L.
   6. Shellacs, Pigmented: VOC not more than 550 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS
2.4 PRIMERS/SEALERS
   A. Interior Latex Primer/Sealer: MPI #50.
   B. Interior Primer sealer, institutional low odor/VPC: MPI #149
   C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.5 METAL PRIMERS
   A. Quick-Drying Alkyd Metal Primer: MPI #76.
   B. Rust-Inhibitive Primer (Water Based): MPI #107.

2.6 WOOD PRIMERS
   A. Interior Latex-Based Wood Primer: MPI #39.

2.7 LATEX PAINTS
   A. Institutional Low-Odor/VOC Latex (Low Sheen): MPI #145 (Gloss Level 3).
   B. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
   C. Epoxy Modified Latex, Interior, Gloss: MPI#115 (Or other Waterproofing Paint designed for hydrostatic resistance)

2.8 DRY FOG/FALL COATINGS
   A. Latex Dry Fog/Fall: MPI #118.

2.9 FLOOR COATINGS
   A. Interior/Exterior Latex Floor & Porch Paint (Low Gloss): MPI #60 (maximum Gloss Level 3).

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
G. Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

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 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.

B. Primer coat to be a different color that intermediate coat to facilitate identification of each 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 Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
   1. Mechanical Work:
      a. Uninsulated metal piping.
      b. Uninsulated plastic piping.
      c. Pipe hangers and supports.
      d. Tanks that do not have factory-applied final finishes.
      e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
      f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
      g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
2. **Electrical Work:**
   
   a. Switchgear.
   
   b. Panelboards.
   
   c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 **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 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.

   B. *Owner must be provided the opportunity to visually inspect all prime coats prior to application of any next coat.*

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 **INTERIOR PAINTING SCHEDULE**

A. **Concrete Substrates, Nontraffic Surfaces:**

   1. **Institutional Low-Odor/VOC Latex System:** MPI INT 3.1M.
   
      a. **Prime Coat:** Institutional low-odor/VOC interior latex matching topcoat.
      
      b. **Intermediate Coat:** Institutional low-odor/VOC interior latex matching topcoat.
      
      c. **Topcoat:** Institutional low-odor/VOC interior latex (semigloss).
B. Concrete Substrates, Traffic Surfaces:

1. Concrete Stain System: MPI INT 3.2E.

2. Water-Based Clear Sealer System: MPI INT 3.2G.

C. Masonry Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 4.2E.

D. Masonry Substrates (Walls) within Toilet Rooms at walls within 18” of urinals or water closets:

1. Epoxy-Modified Latex System or other Masonry Waterproofing Paint.
   a. Prime Coat: Interior/exterior latex block filler designed for hydrostatic resistance.
   b. Intermediate Coat: Epoxy-modified latex matching topcoat or other waterproofing paint designed for hydrostatic resistance.
   c. Topcoat: Epoxy-modified latex or other waterproofing paint designed for hydrostatic resistance. (semigloss).

E. Steel Substrates:

1. Water-Based Dry-Fall System-Exposed structure to be painted: MPI INT 5.1C.
   b. Topcoat: Latex dry fog/fall.

2. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
   a. Prime Coat: Rust-inhibitive primer (water based).

F. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.
G. Dressed Lumber Substrates: Including architectural woodwork.
   1. Institutional Low-Odor/VOC Latex System: MPI INT 6.3V.

H. Wood Panel Substrates: Including medium-density fiberboard.
   1. Latex System: MPI INT 6.4R.
      c. Topcoat: Interior latex (gloss).

I. Gypsum Board and Plaster Substrates:
   1. Institutional Low-Odor/VOC Latex System for typical walls: MPI INT 9.2M.
   2. Institutional Low-Odor/VOC Latex System for walls in all toilet rooms, janitors closets, wet areas, and kitchen walls:
      a. System to have (1) prime coat, (1) intermediate coat, and (1) topcoat, and be an epoxy waterproof painting system.

END OF SECTION 09 91 23
SECTION 10 11 00 - 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. Marker Boards
   2. Tack Boards
   3. Visual Display Unit Accessories

B. Related Requirements:
   1. Section 09 22 16 "Non-Structural Metal Framing" for framing mounting substrates
   2. Section 09 29 00 “Gypsum Board” for GWB mounting substrates

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.

B. Shop Drawings: For visual display units.
   1. Include plans, elevations, sections, details, and attachment to other work.
   2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
   3. Show locations and layout of special-purpose graphics.
   4. Include sections of typical trim members.

C. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:
   1. Samples of facings for each visual display panel type, indicating color and texture.
   3. Sample of cork wall covering and metal edge strip.
   4. Actual factory-finish color samples, applied to aluminum substrate.
   5. Include accessory Samples to verify color selected.
D. Samples for Verification: For each type of visual display unit indicated.

1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch long sections of each trim profile.
3. Display Rail: 6-inch long section of each type.
4. Accessories: Full-size Sample of each type of accessory.

E. Product Schedule: For visual display units.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of tackboards.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units 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.

B. Source Limitations: Obtain visual display surfaces of same type from single source manufacturer.

1.7 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. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site.

1.8 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.

1.9 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Surfaces lose original writing and erasing qualities.
   b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of visual display unit 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: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.3 MARKERBOARD PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Best Rite Manufacturing
2. Claridge Products and Equipment
3. ADP Lemco, Inc.
4. Nelson Adams (NAPCO)

B. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core
material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Face Sheet Thickness: 0.021 inch uncoated base metal thickness.
2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.4 TACKBOARD PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Forbo
   2. Best Rite Manufacturing
   3. Claridge Products and Equipment

B. Tackboard Panels: Natural cork tack board ¼-inch thick natural cork sheet compressed with linseed oil and integral color throughout, factory laminated burlap backing. Factory laminate core face sheet under pressure to ¼-inch thick particleboard backing.

2.5 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.

C. Particleboard: ANSI A208.1, Grade M-1.

D. Extruded Aluminum: ASTM B 221, Alloy 6063.

E. Adhesives for Field Application: Mildew-resistant, non-staining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

2.6 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.

2.7 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.

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.

D. Prepare wall surface to receive cork wall covering with skim coat or wall line as recommended suitable substrate for cork wall covering.

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, balanced around center of board, as acceptable to Architect.
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.

C. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches on center. Secure tops and bottoms of boards to walls.

D. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at 36-inches above finished floor to top of chalktray.

E. Display Rails: Install rails at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than 16 inches on center.

1. Mounting Height: 60 inches above finished floor to top of rail.

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 10 11 00
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. Interior Panel signs
2. Cast Metal Architectural Letters Signage

B. Related Sections include the following:

1. Division 22, Section 22 05 53 "Identification for Plumbing Piping and Equipment for labels, tags, and nameplates for plumbing systems and equipment.
2. Division 23, Section 23 05 53 “Identification for HVAC Piping and Equipment” for labels, tags, and nameplates for HVAC systems and equipment.
3. Division 26 Sections for electrical service and connections for illuminated signs.
4. Division 26, Section 26 05 53 "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
5. Division 26, Section 26 51 00 "Interior Lighting" for illuminated Exit signs.

1.3 DEFINITIONS


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, tyestyles, 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. Signage Sheet material.
2. Text and Graphics Colors.

D. Samples for Verification: For the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:

2. Sheet Material: 6 by 6 inches (minimum size) for each color required.

E. Sign Schedule: Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.
B. Warranty: Special warranty specified in this Section.
C. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.
B. Fabricator Qualifications: Shop that 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.
C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

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.
1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Deterioration of metal and polymer finishes beyond normal weathering.
   b. Deterioration of embedded graphic image colors and sign lamination.

2. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.

B. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.

C. 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. Vista Systems (Basis of Design)
   3. Best Sign Systems Inc.
   4. Innerface Sign Systems, Inc.
   5. Corum Signs.

B. Subject to compliance with requirements, provide products by one of the following:

   1. Vista Systems (Basis of Design)
   3. Best Sign Systems Inc.
   4. Innerface Sign Systems, Inc.
   5. Corum Signs.

C. 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. Laminated Sheet: High-pressure sandblasted stock with contrasting color face laminated to acrylic core as selected by Architect from manufacturer's full range.
2. Laminated, Sandblasted Polymer: Raised text 1/32 inch above surface with contrasting colors as selected by Architect from manufacturer's full range and laminated to acrylic back.
3. Edge Condition: Square cut, smooth.
   a. Wall mounted with two-face tape and adhesive.
   b. Manufacturer's standard anchors for substrates encountered.
6. Color: As selected by Architect from manufacturer's full range.
7. Tactile Characters: Characters raised 1/32 inch above surface with contrasting colors. Braille dot height shall be raised above adjacent surface 0.025-inch minimum to 0.037-inch maximum.
8. Composite Sheet Thickness: 0.125 inches.

G. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

2. Raised-Copy Thickness: Not less than 1/32 inch.

J. Panel Sign Schedule:

1. Refer to Drawings for Signage Elevations.
   a. Provide and install (1) Type A1, A2, or A3 ‘Room Identification Sign’ for each door within the project. Locations to be chosen in the field by the Architect and Owner. At exterior doors signage will be placed at the exterior.
   b. Provide and install (3) Type B ‘Evacuation Plan’ signs on the interior of the building. Locations to be chosen in the field by the Architect and Owner.
   c. Provide and install (3) Type C ‘Smoke Free Facility’ signs on the interior of the building. Locations to be chosen in the field by the Architect and Owner.

2.3 CAST METAL LETTERS

A. Furnish letters and hardware necessary to install cast letters as shown on the drawings and herein specified.

B. Subject to Compliance with requirements, provide cast metal letters as manufactured by Gemini Incorporated or approved equal.

C. Materials: Cast Aluminum (514 Alloy)

D. Finish: Painted
E. Mounting Standard: Top of letters drilled and tapped for mounting to ceiling with 10-24 threaded studs and aluminum spacer sleeves.

2.4 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.

2.5 FABRICATION

A. General: Provide manufacturer's standard signs of configurations indicated.

1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.

2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.

3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.

4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.6 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.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish, complying with AAMA 611.
2.8 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 five 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. Mechanical Fasteners: Use non-removable 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.

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 10 14 23
SECTION 10 22 30 – OPERABLE PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Manually operated, paired panel operable partitions.

B. Related Sections include the following:
   1. Division 3 Sections for concrete tolerances required.
   2. Division 5 Sections for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
   3. Division 6 Sections for wood framing and supports, and all blocking at head and jambs as required.
   4. Division 9 Sections for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.

B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request. Provide a panel when that when tested for noise isolation according to ASTM E-336-05, determined by ASTM E-413 achieves the NIC score specified.

C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 "Standard Practice for Architectural Application and Installation of Operable Partitions."

1.4 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.

B. Shop Drawings: Show location and extent of operable partitions. Include plans, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.6 WARRANTY
A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
B. Partition Warranty period: Two (2) years from date of shipment.
C. Suspension System Warranty: Five (5) years from date of shipment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATIONS
A. Manufacturers: Subject to compliance with requirements, provide Basis of Design: Acousti-Seal Encore by Modernfold, Inc. or approved equal by:
   1. Huffcore
   2. Moderco
   3. Nanawall
B. Products: Subject to compliance with the requirements, provide the following product:
   1. Basis of Design: Acousti-Seal Encore - Paired Panel: Manually operated paired panel operable partition

2.2 OPERATION
A. Paired Panel: Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals and automatic top seals.
B. Final Closure:
   1. Horizontally expanding panel edge with removable crank

2.3 PANEL CONSTRUCTION
A. Nominal 4.25-inch thick panels in manufacturer's standard 51-inch widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped
and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.

B. Panel skin shall be:
   1. Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
      a. 54 STC
      b. 44 NIC

C. Hinges for Panels, Closure Panels, Pass Doors, and Pocket Doors shall be:
   1. Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.

D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at all panel joints.

E. Panel Weights:
   1. 54 STC - 9.5 lbs./square foot

2.4 PANEL FINISH

A. Panel finish shall be factory applied, Class "A" rated material. Finish shall be the same on both sides of partition. Configuration as shown on drawings.
   1. Markerboard: White enamel on steel, bonded to the face of the panel with horizontal trim without exposed fasteners. Trim is not acceptable on vertical edges to provide uninterrupted work surface.
   2. Full height trackable surface with Fabric Covering
      a. Fabric to be selected by Architect from Manufacturer’s full range of choices.

B. Panel Trim: Exposed panel trim of one consistent color: To be selected by Architect from Manufacturer’s standard color.

2.5 SOUND SEALS

A. Vertical Interlocking Sound Seals between panels: Aluminum astragals, with tongue and groove configuration in each panel edge. Rigid plastic astragals are not acceptable.

B. Horizontal Top Seals shall be Modernfold SureSet™ automatic operable top seals, manually operated top seals not required or permitted.

C. Horizontal bottom floor seals shall be Modernfold Sureset™ bottom seal:
   1. Modernfold SM2 Bottom Seal. Manually activated seals providing nominal 2" (51mm) operating clearance with an operating range of +0.50" (13mm) to -1.50" (38mm). Seal shall be operable from panel edge or face. Extended seal shall exert nominal 120 pounds downward force to the floor throughout operating range.
2.6 SUSPENSION SYSTEM

A. #17 Suspension System
   1. Suspension Tracks: Minimum 11-gauge, 0.12-inch (3.04mm) roll-formed steel track, suitable for either direct mounting to a wood header or supported by adjustable steel hanger brackets, supporting the load-bearing surface of the track, connected to structural support by pairs of 0.38-inch (10mm) diameter threaded rods. Aluminum track is not acceptable.
      a. Exposed track soffit: Steel, integral to track, and pre-painted off-white.
   2. Carriers: One all-steel trolley with steel-tired ball bearing wheels per panel (except hinged panels). Non-steel tires are not acceptable.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.

B. Install operable partitions and accessories after other finishing operations, including painting have been completed.

C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 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 partitions. Proceed with installation only after unsatisfactory conditions have been corrected.
3.5 DEMONSTRATION

A. Demonstrate proper operation and maintenance procedures to Owner's representative.

B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION 10 22 30
SECTION 10 26 00 - WALL AND DOOR PROTECTION

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. Stainless Steel Corner Guards
B. Stainless Steel Wall Plate

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
   2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.
   1. Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.
   1. Include Samples of accent strips and accessories to verify color selection.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
   1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. 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.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with turn to match wall condition.

1. Subject to compliance with requirements, provide products from one of the following manufacturers:

   a. Koroseal Wall Protection Systems
   b. Wallguard
   c. The Pawling Corporation


   a. Thickness: Minimum 16-gauge steel
   b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes
2.4 STAINLESS STEEL WALL SHEET

A. Surface-Mounted, Stainless Steel Sheet

1. Subject to compliance with requirements, provide products from one of the following manufacturers:
   a. CS Acrovyn, Basis of Design
   b. Koroseal Wall Protection Systems
   c. Wallguard
   d. The Pawling Corporation

2. Material: Stainless-steel sheet, Type 304
   a. Thickness: Minimum 16-gauge steel
   b. Finish: Directional satin, No. 4.
   c. Diamond Plate Texture

3. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes

2.5 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components as shown on drawings.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. 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 and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

END OF SECTION 10 26 00
SECTION 10 28 00 - 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. Toilet paper dispensers.
   2. Waste Receptacles.
   5. Soap Dispensers.
   6. Paper Towel Dispensers.
   7. Warm-air dryers (Recessed and Surface Mounted)
   8. Custodial accessories.
   10. Mirrors

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. 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 OWNER-FURNISHED MATERIALS
   A. Owner-Furnished Materials:
      1. Soap dispensers (owner-furnished, owner installed; contractor to provide blocking)
      2. Paper towel dispensers (owner-furnished, owner installed; contractor to provide blocking)
      3. Waste receptacle (owner-furnished, contractor installed; contractor to provide blocking)

2.2 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.

2.3 PUBLIC-USE WASHROOM ACCESSORIES
   A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
   B. Owner-Provided, Contractor Installed Equipment
      1. Soap Dispenser
      2. Toilet Paper Dispensers
      3. Paper Towel Dispenser
   C. Grab Bar, Basis of Design Bobrick, Model B6806 by length as indicated on the drawings:
      1. Mounting: Flanges with concealed fasteners
      2. Material: Stainless steel, 1/8-inch thick, smooth, No. 4 (satin) finish
      4. Configuration and Length: As indicated on Drawings
      5. Contractor Furnished, Contractor Installed
   D. Feminine Hygiene Disposal Unit, Basis of Design Bobrick Model B-5270
1. Mounting: Surface mounted
2. Receptacle: Removable

E. Coat Hook
1. Basis of Design Product: Bobrick Washroom Equipment, Inc.; Model B-6707
2. Description: Surface-mounted utility hook. Flange and support arm shall be 22 gauge and equipped with a concealed, 15-gauge mounting bracket that is secured to a concealed 16-gauge wall plate with a stainless steel setscrew. Cap shall be 10 gauge, welded to the support arm.

F. Baby Changing Station, Basis of Design, Koala Model KB110-SSWM
1. Materials: FDA approved blow molded high-density polyethylene (HDPE) clad in 18-gauge Type 304 Stainless steel, brushed finish.
2. Operation: Concealed pneumatic cylinder providing controlled, slow opening and closing of the changing station bed.
3. Hinge mechanism: Reinforced full length steel-on-steel hinge with integrated hook plate.
4. Changing Surface: Contoured, concave and smooth
5. Safety Straps: Replaceable, snap-lock nylon protective holding straps.
7. Mounting: Surface mounted with manufacturer provided mounting hardware and 11-gauge steel mounting plates spaced as recommended by the manufacture.
8. Unit shall have no hinge structure exposed on the interior or exterior surface; shall be provided with two bag hoods and built in liner dispenser with 25 line capacity

G. Mirror Unit, Basis of Design, Bobrick Model B-290 Series
1. Frame: Stainless-steel angle, type 304 with satin finish and vertical grain.
   a. Corners: Welded and ground smooth.
   a. Back shall be galvanized steel, with integral horizontal edge
3. Size: As indicated on Drawings

2.4 WARM-AIR DRYERS
A. Source Limitations: Obtain warm-air dryers from single source from single manufacturer.
B. Warm-Air Dryer:
2. Description: High-speed, warm-air hand dryer.
3. Mounting: Surface Mounted
   a. Operation Time: The dryer shall operate as long as hands are under the air outlet; 35-second lockout feature if hands are not removed.
5. Cover Material and Finish: Die-cast zinc alloy – One-piece, heavy-duty rib-reinforced, lightweight, unbreakable, rustproof and all exposed surfaces shall be finished with chip-proof, electrostatically applied epoxy paint; Graphite textured paint.
6. Electrical Requirements: 115 V, 13 A, 1500 W
7. ADA compliant surface-mounted hand dryer: 4” maximum projection from wall

2.5 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Utility Shelf with Mop and Broom Holders and Rag Hooks:
   1. Basis of Design Product: Bobrick Washroom Equipment, Inc.; Classic Series Model B-239x34
      Description: Utility shelf with 3 mop/broom holders and 4 rag hooks.
   2. Mounting Base: All-welded, 18-8, Type 304, 18 gauge stainless steel with satin finish.
   3. Length: 34 inches.
   4. Shelf: All-welded, 18-8, Type 304, 18 gauge stainless steel with satin finish; 8 inches deep with 3/4 inch return edges on three sides, hemmed front edge.
   5. Shelf Support Brackets: 18-8, Type 304, 16 gauge stainless steel with satin finish. Welded to mounting base and shelf.
   6. Mop and Broom Holders: Replaceable, spring-loaded rubber cams with anti-slip coating; accommodates handles from 7/8 inch to 1-1/4 inch in diameter; with plated steel retainers.

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 F 446.

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 10 28 00
SECTION 10 44 13 - 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.

1.4 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.

1.5 SEQUENCING
   A. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

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 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.
   1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
      b. GMR International Equipment Corporation.
      c. Guardian Fire Equipment, Inc.
      d. JL Industries, Inc.; a division of the Activar Construction Products Group.
      e. Larsens Manufacturing Company.
      f. Modern Metal Products, Division of Technico Inc.
      g. Nystrom, Inc.
      h. Potter Roemer LLC.
      i. Strike First Corporation of America.

B. Cabinet Construction: Nonrated.

C. Cabinet Sizing: Cabinet must be sized to fit MP5 fire extinguishers.

D. Cabinet Material: Stainless-steel sheet.
   1. Shelf: Same metal and finish as cabinet.

E. 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. Square-Edge Trim: 1-1/4- to 1-1/2-inchbackbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: Stainless-steel sheet.

H. Door Material: Stainless-steel sheet.

I. Door Style: Vertical duo panel with frame.

J. Door Glazing: Tempered float glass (clear).

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide projecting door pull and friction latch, Larsen-Loc.
   2. Provide manufacturer's standard hinge permitting door to open 180 degrees.
L. 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. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
      a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
         1) Location: Applied to cabinet door.
         2) Application Process: Pressure-sensitive vinyl letters.
         3) Lettering Color: Black.
         4) Orientation: Vertical.

M. Materials:
   1. Stainless Steel: ASTM A 666, Type 304.
      a. Finish: No. 4 directional satin finish.

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. 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

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.

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 or, if not indicated, at heights acceptable to authorities having jurisdiction.

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. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semi-recessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification: Apply vinyl lettering at locations indicated.

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 10 44 13
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 10 51 29 – PHENOLIC LOCKERS & BENCHES

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. Phenolic lockers.
2. Benches.

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 locker and bench.

B. Shop Drawings: For phonolic lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show details full size.
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 lockers.
5. Show locker fillers, trim, base, sloping tops, and accessories.
6. Show locker identification system and numbering sequence.

C. Samples for Initial Selection: For each type of the following:

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products:

1. Phenolic panels, not less than 3 by 3 inches, for each type, color, pattern, and surface finish.
2. Exposed locker hardware and accessories, one unit for each type and finish.
3. Corner pieces of locker front frame joints between stiles and rail, as well as exposed end pieces, not less than 18 inches wide by 18 inches high by 6 inches deep (457 mm wide by 450 mm high by 152 mm deep).
4. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
   1. Include recommendations for periodic cleaning and maintenance of each component

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. Locker doors, complete with specified door hardware. Furnish no fewer than one door of each type and color installed.
   2. Units of the following locker hardware items equal 1 unit installed for each type and finish installed:
      a. Hinges.
      b. Pulls.
      c. Shelf rests.
      d. Cylinder locks.
      e. Blank identification plates.
      f. Hooks.

1.7 QUALITY ASSURANCE

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

B. Deliver master and control keys to Owner by registered mail or overnight package service.
1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
   1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

A. Coordinate sizes and locations of concealed wood support bases.
   1. Requirements are specified in Section 06 10 00 "Rough Carpentry."

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Faulty operation of locks or hardware.
      c. Deterioration of wood, finishes, and other materials beyond normal use.
   2. Warranty Period: Three (3) years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers and benches indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1

B. 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: [25] [75] or less.
   2. Smoke-Developed Index: 450 or less.

C. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 19 percent.

D. Accessibility Requirements: Comply with requirements of ADA and requirements of authorities having jurisdiction

2.2 PHENOLIC LOCKERS

Basis-of-Design Product: Subject to compliance with requirements, provide Partition Systems International of South Carolina®; Phenolic Lockers or comparable product by one of the following:
   1. Bobrick Washroom Equipment, Inc.
   2. Bradley Corporation.
   3. Columbia Lockers®, a division of PSiS

B. Construction Style: Manufacturer's standard mortise and tenon. Butt joints are unacceptable.

C. Final Assembly: Manufacturer's standard factory assembly.

D. Configuration: 2 Tier

E. Locker Body: Fabricated from phenolic panels.
   1. Side Panels: 5/16 inch thick.
   3. Top Panel: 3/8 inch thick.

F. Doors: 1/2 inch (13 mm) thick, solid phenolic panel fabricated to full width of locker; frameless with perimeter ventilation.

G. End Panels: 1/2 inch (13 mm) thick, solid phenolic matching door style, material, construction, and finish.
H. Shelves: 3/8 inch (10 mm) thick, solid phenolic.
I. Toe-Kick Plates: 1/2-inch- (13-mm-) thick, solid phenolic panel matching door faces.
J. Colors: As selected by Architect from manufacturer's full range of standard colors.
K. Edge Color: Matching panel face.

2.3 MATERIALS
A. Phenolic: Solid phenolic with same color throughout material. Laminated surfaces are unacceptable.
B. Furring, Blocking, Shims, and Hanging Strips: hardwood lumber, kiln dried to less than 15 percent moisture content.
C. Anchors: Material, type, size, and finish as 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.
D. Wood Support Base: 2-by-4-inch nominal-size lumber treated with manufacturer's standard preservative-treatment, pressure process.

2.4 HARDWARE
A. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
B. Frameless Hinges (European Type): Fully concealed, nickel-plated steel, with not less than 125 degrees of opening.
   1. Provide three hinges for doors more than 36 inches high.
C. Wire Pulls: Back mounted; 4 inches long, 5/16 inch in diameter
D. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; chrome finished. Attach hooks with at least two fasteners.
   1. Provide hooks on inside left & right sides of locker 4” from top.
   2. Provide two single-prong wall hooks for each compartment of double-tier lockers.
E. Exposed Hardware Finish:
   1. Satin chrome unless otherwise indicated.
   2. Unless otherwise indicated, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
2.5 ACCESSORIES

A. Number Identification Plates: 1-inch-high by 4-inch-wide, etched, embossed, or stamped, stainless-steel plates with black numbers and letters at least 1/2 inch high. Identify lockers in sequence indicated on Drawings. Finish plates to match other locker hardware.

2.6 BENCHES

A. Pedestal-Leg Locker Benches: Bench top supported by pedestal legs, minimum of two pedestals for each bench, with overall height of 17.25 inches measured from top of bench to floor, as follows:
   1. Metal Pedestal Legs: 16.5 inches (419 mm) high, 11-gauge, Type 304 stainless steel, satin finish with 8-inch diameter flanges.
   2. Bench Tops: 3/4-inch thick, solid phenolic.
      a. Color: As selected by Architect from manufacturer's full range.
      b. Width: provide 20-inch accessible width.
      c. Length: 60

B. Wall Brackets: Black, powder-coated aluminum plate, 0.125 inch thick.

2.7 FABRICATION

A. Fabricate and provide factory preassembled lockers, complete with hardware and accessories.

B. Fabricate each locker with shelves, a single door and frame, a single top, bottom, and back, and with common intermediate uprights separating compartments.
   1. Fabricate lockers to dimensions, profiles, and details indicated.

C. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of scratches, and chips. Factory machine components to suit attachments. Make joints tight and true.
   1. Fabricate lockers using manufacturer's standard mortise and tenon construction.
   2. Provide end panels as required to complete installation as indicated by Drawings.

D. Accessible Lockers: Fabricate as follows:
   1. Locate bottom shelf no lower than 15 inches above finished floor.
   2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above finished floor.

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Trial fit assemblies at fabrication 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 the parts fit as intended, and check measurements.
of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

2. Use only manufacturer's brackets, nuts, bolts, screws, and other anchoring devices for assembly.

F. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition lockers to average prevailing humidity conditions in installation areas before installation.

B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install lockers in accordance with manufacturer's written instructions.

B. Install wood support base with 1/2-inch-thick, plywood top.

C. Install lockers level, plumb, and true; use concealed shims.

D. Connect groups of lockers together with manufacturer's standard stainless steel, theft proof fasteners, through predrilled holes in locker interior. Fit lockers accurately together to form flush, tight, hairline joints.

E. Install lockers without distortion for doors and drawers to fit and align with openings. Adjust hardware to center doors and drawers in openings, and provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Installation Tolerance: Maximum 1/8- in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

F. Locker Anchorage: Fasten lockers through back, near top and bottom, at ends with anchoring devices furnished, and spaced not more than 16 inches o.c.

G. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

H. Attach sloping-top units to lockers, with end panels covering exposed ends.

I. Install number identification plates after lockers are in place.
   1. Attach number identification plate on each locker door, mounted behind locker pull handle or lock.
   2. Attach name identification plate holder on each locker door, centered, with a minimum two screws with finish matching name identification plate holder.
   3. Insert name identification plate into matching nameplate holder on each door.

J. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 60 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.4 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Verify that integral locking devices operate properly.

3.5 PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Clean exposed surfaces of lockers and hardware.

C. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 51 29
SECTION 12 36 61.19 - QUARTZ AGGLOMERATE 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. Quartz agglomerate countertops.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Sustainable Design Submittals:

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.

2. Show direction of directional pattern, if any.

D. Samples for Initial Selection: For each type of material exposed to view.

E. Samples for Verification: For the following products:

1. Countertop material, 6 inches (150 mm) square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.
1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
   1. Build mockup of typical countertop as shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Basis-of-Design Product: Subject to compliance with requirements, provide: Quartz Countertops, as manufactured by HanStone Quartz, or a comparable product by one of the following:
   1. Cambria USA
   2. Silestone USA
   3. Ceasarstone USA

B. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
   1. Colors and Patterns: Hanstone Quartz Aramis

C. Particleboard: ANSI A208.1, Grade M-2

D. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium

B. Configuration:

1. Front and Waterfall: Straight, slightly eased at top

C. Countertops & Splashes: 3/4-inch (2cm) thick, quartz agglomerate with front edge and edges at sinks built up with same material.

D. Joints: Fabricate countertops without joints.

E. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
   a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.

2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
   1. Install metal splines in kerfs in countertop edges at joints where indicated. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
   2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.

H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
   1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 12 36 61.19
SECTION 21 13 13 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipes, fittings, and specialties.
   2. Specialty valves.
   4. Pressure gauges.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For wet-pipe sprinkler systems.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, or BIM model, drawn to scale, on which items of other systems and equipment are shown and coordinated with each other, using input from installers of the items involved.

B. Qualification Data: For qualified Installer.

C. Design Data:
   1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

E. Field quality-control reports.
1.4 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

1.5 QUALITY ASSURANCE
   A. Installer Qualifications:
      1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems
         and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
      a qualified testing agency, and marked for intended location and application.
   B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with
      NFPA 13.
   C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
   D. Delegated Design: Engage a minimum NICET III layout technician to design wet-pipe sprinkler
      systems.
      1. Available fire-hydrant flow test records indicate the following conditions:
         a. Date: 11-16-2015.
         b. Performed by: Michael Knupp and Melvin Riddle of Premier Fire Protection.
         c. 
         d. Static Pressure at Residual Fire Hydrant R: 74 psig.
         f. Residual Pressure at Residual Fire Hydrant R: 57 psig.
      2. Sprinkler system design shall be approved by authorities having jurisdiction.
         a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including
            losses through water-service piping, valves, and backflow preventers.
         b. Sprinkler Occuancy Hazard Classifications:
            1) Building Service Areas: Ordinary Hazard, Group 1.
            2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
            3) Elevator Machine Room and Hoistway: Ordinary Hazard, Group 1.
            4) General Storage Areas: Ordinary Hazard, Group 1.
            5) Laundries: Ordinary Hazard, Group 1.
7) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
8) Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined in accordance with NFPA 13 for Seismic design category C.

2.2 STEEL PIPE AND FITTINGS

A. All new piping shall be steel.

B. Schedule 40, Black-Steel Pipe with threaded ends and uncoated, gray-iron fittings for pipes NPS 2 and smaller.

C. Schedule 10, Black-Steel Pipe with roll-grooved ends and uncoated fittings for NPS 2.5 and larger.

D. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.


F. Malleable- or Ductile-Iron Unions: UL 860.


H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch.
   b. Class 150 and Class 300, Ductile-Iron or Steel, Raised-Face Flanges: Ring-type gaskets.

I. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Pressure Rating: 175-psig minimum.
   2. Uncoated Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
   3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
2.3 CPVC FITTINGS

A. CPVC Fittings: UL listed, for 175-psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
   1. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
   2. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.

2.4 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Specialty Valves Pressure Rating: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

2.5 AIR VENT

A. Automatic Air Vent Assembly:
   1. Description: Automatic dual air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly.
   2. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler system.
   3. Vents oxygen continuously from system.
   4. Float valve to prevent water discharge.

2.6 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
   4. Type: Mechanical-tee and -cross fittings.
   5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes: Brass and painted.
E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.

F. Sprinkler Guards:
2. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 WATER-SUPPLY CONNECTIONS
A. Connect new sprinkler piping to existing system.

3.2 PIPING INSTALLATION
A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.
I. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13 for Seismic design category C.

J. Fill sprinkler system piping with water.

K. Install sleeves for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection.

D. Specialty Valves:
   1. Install valves in vertical position for proper direction of flow, in main supply to system.

E. Air Vent:
   1. Provide at least one air vent in each wet pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
   2. Provide dielectric union for dissimilar metals, ball or globe valve, and strainer upstream of automatic air vent.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. At contractor’s option, sprinklers may be installed into flexible sprinkler hose attached to brackets on ceiling grid.

3.6 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Schedule 40, Black-Steel Pipe with threaded ends and uncoated, gray-iron fittings for pipes NPS 2 and smaller.

C. Schedule 10, Black-Steel Pipe with roll-grooved ends and uncoated fittings for NPS 2.5 and larger.

3.10 SPRINKLER SCHEDULE.

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Rooms with Wooden Slat Ceiling: Concealed sprinklers with cover plates to match wooden slats.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate for gyp-board ceilings and ACT tiles or Rough brass with factory-painted cover plates to match wooden slat ceiling
2. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13
 SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
2.3 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 22 05 13
SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Flexible-hose packless expansion joints.
   2. Metal-bellows packless expansion joints.
   3. Alignment guides and anchors.
   4. Pipe loops and swing connections.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
   2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
   3. Alignment Guide Details: Detail field assembly and attachment to building structure.
   4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS
A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS
A. Maintenance Data: For expansion joints to include in maintenance manuals.
1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Flex Pression Ltd.
   b. Flex-Hose Co., Inc.
   c. Flexicraft Industries.
   d. Mason Industries, Inc.
   e. Metraflex Company (The).
   f. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.

3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

   a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
B. Metal-Bellows Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. Adsco Manufacturing LLC.
b. American BOA, Inc.
c. Badger Industries, Inc.
d. Expansion Joint Systems, Inc.
e. Flex Pression Ltd.
f. Flex-Hose Co., Inc.
g. Flexicraft Industries.
h. Flex-Weld, Inc.
i. Flo Fab Inc.
j. Hyspan Precision Products, Inc.
k. Mason Industries, Inc.
l. Metraflex Company (The).
m. Proco Products, Inc.
n. Senior Flexonics Pathway.
o. Tozen Corporation.
q. Unaflex.
r. Unisource Manufacturing, Inc.
s. Universal Metal Hose.
t. WahlcoMetroflex.


3. Type: Circular, corrugated bellows.

4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.

5. Configuration: Single joint class(es), unless otherwise indicated.

   
a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. Adsco Manufacturing LLC.
b. Advanced Thermal Systems, Inc.
c. Flex-Hose Co., Inc.
d. Flexicraft Industries.
e. Flex-Weld, Inc.
f. Hyspan Precision Products, Inc.
g. Mason Industries, Inc.
h. Metraflex Company (The).
i. Senior Flexonics Pathway.
j. U.S. Bellows, Inc.
k. Unisource Manufacturing, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:
   1. Steel Shapes and Plates: ASTM A36/A36M.
   2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
   4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
   5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
      a. Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION
   A. Install expansion joints of sizes matching sizes of piping in which they are installed.
   B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer’s written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 22 05 16
SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

2. Zurn Industries, LLC.

B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber, high-temperature-silicone, or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel or composite plastic.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dow Corning Corporation; Dow Corning 758 Silicone Weather Barrier Sealant.
b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2350.
e. Sherwin-Williams Company (The); White Lightning Silicone Ultra All Purpose Sealant.
B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. May National Associates, Inc.; a subsidiary of Sika Corporation U.S.; Bondaflex Sil 200 MJS.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Smooth-On; Soma Foama 15.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces.

   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves or steel pipe sleeves.
   b. Piping NPS 6 and Larger: Cast-iron pipe sleeves or steel pipe sleeves.

2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system or steel pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system or steel pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system or steel pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
b. Piping and Larger: Cast-iron pipe sleeves with sleeve-seal system or steel pipe sleeves with sleeve-seal system.

   1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

   a. Piping Smaller Than NPS 6: Steel pipe sleeves or PVC pipe sleeves.
   b. Piping NPS 6 and Larger: Steel pipe sleeves or PVC pipe sleeves.

5. Interior Partitions:

   a. Piping Smaller Than NPS 6: Steel pipe sleeves or PVC pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 22 05 17
SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. BrassCraft Manufacturing Co.; a Masco company.
   2. Dearborn Brass.
   4. Keeney Manufacturing Company (The).
   5. Mid-America Fittings, Inc.
   6. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.3 FLOOR PLATES
A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
      b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
      c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
C. Install floor plates for piping penetrations of equipment-room floors.
D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping: One-piece, floor plate.
   2. Existing Piping: Split floor plate.
3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 22 05 18
SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Liquid-in-glass thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Gage attachments.
   5. Test plugs.
   6. Test-plug kits.
   7. Sight flow indicators.
B. Related Requirements:
   1. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS
A. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. FNW.
   b. Proflo.
   c. Weiss Instruments, Inc.

3. Case: Plastic; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue, red, or green organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
8. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   3. Material for Use with Copper Tubing: Lead free brass.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Proflo.
   b. WATTS.
   c. Weiss Instruments, Inc.

3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Peterson Equipment Co., Inc.
   2. Thermal Applications Group, Inc.
   3. Winters Instruments

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Neoprene or EPDM self-sealing rubber.
2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Peterson Equipment Co., Inc.
2. Thermal Applications Group, Inc.
3. WATTS.

B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Diversitech Corporation.
2. Dwyer Instruments, Inc.
3. SUPCO

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.
   1. Provide test plugs adjacent to all analog temperature and pressure instruments.
   2. Provide test plugs adjacent to all locations where sensor or analog instrument readings will require calibration verification.

I. Install thermometers in the following locations:
   1. Inlet and outlet of each water heater.
   2. Inlets and outlets of each domestic water heat exchanger.
   3. Inlet and outlet of each domestic hot-water storage tank.
   4. Inlet and outlet of each remote domestic water chiller.
   5. Inlet and outlet of each domestic water pump.
   6. Outlet of each domestic hot water return thermostatic balancing valve.
   7. In each domestic cold water building service entrance riser.

J. Install pressure gages in the following locations:
   1. Building water service entrance into building.
   2. Inlet and outlet of each pressure-reducing valve.
   3. Suction and discharge of each domestic water pump.
   4. Inlet and outlet of each domestic water heater.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be the following:
   2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:
   2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each remote domestic water chiller shall be the following:
   2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F and 0 to 150 deg C.

C. Scale Range for Domestic Cooled-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:
   1. Liquid-filled Solid-front, direct-mounted, metal case.
   2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.
B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
   1. Liquid-filled Solid-front, direct-mounted, metal case.
   2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
   1. Liquid-filled Solid-front, direct-mounted, metal case.
   2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 200 psi.

B. Scale Range for Domestic Water Piping: 0 to 200 psi.

END OF SECTION 22 05 19
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 22 05 23.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Brass ball valves.
      2. Bronze ball valves.

1.3 DEFINITIONS
   A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of valve.
      1. Certification that products comply with NSF 61 Annex G.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Prepare valves for shipping as follows:
      1. Protect internal parts against rust and corrosion.
      2. Protect threads, flange faces, and soldered ends.
   B. Use the following precautions during storage:
      1. Maintain valve end protection.
      2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
   C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B31.9 for building services piping valves.


D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
   2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.
   2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
   3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, Three-Piece with Full Port and Brass Trim:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; Conbraco Industries, Inc.
      b. Jomar Valve.
      c. KITZ Corporation.
      d. NIBCO INC.
      e. WATTS.
2. Description:
   
   b. CWP Rating: 600 psig.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

B. Brass Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
      a. Apollo Valves; Conbraco Industries, Inc.
      b. Marwin Valve; Richards Industries.
      c. NIBCO INC.

   2. Description:
      
      b. CWP Rating: 600 psig.
      d. Body Material: Forged brass.
      e. Ends: Threaded and soldered.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Full.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, Three-Piece with Full Port and Bronze or Brass Trim:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. DynaQuip Controls.
      c. Hammond Valve.
      d. Milwaukee Valve Company.
      e. NIBCO INC.
      f. Red White Valve Corp.
      g. WATTS.
2. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Bronze or brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

B. Bronze Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. WATTS.

2. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.
D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint or grooved ends instead of threaded ends.
2. Brass ball valves, three-piece with full port and brass or stainless-steel trim.
3. Bronze ball valves, three-piece with full port and bronze or brass or stainless-steel trim.

END OF SECTION 22 05 23.12
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 22 05 23.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze swing check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder joint.
   5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.


E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Apollo Flow Controls; Conbraco Industries, Inc.
      c. Crane; Crane Energy Flow Solutions.
      d. Hammond Valve.
      e. Jenkins Valves; Crane Energy Flow Solutions.
      f. KITZ Corporation.
      g. Macomb Groups (The).
      h. Milwaukee Valve Company.
      i. NIBCO INC.
      j. Powell Valves.
      k. Red White Valve Corp.
l. Stockham; Crane Energy Flow Solutions.
m. WATTS.

2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Crane; Crane Energy Flow Solutions.
      c. Hammond Valve.
      d. Jenkins Valves; Crane Energy Flow Solutions.
      e. KITZ Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Red White Valve Corp.
      i. Stockham; Crane Energy Flow Solutions.
      j. WATTS.

   2. Description:
      a. Standard: MSS SP-80, Type 4.
      b. CWP Rating: 200 psig.
      c. Body Design: Horizontal flow.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: PTFE.

C. Bronze Swing Check Valves with Bronze Disc, Class 150:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Apollo Flow Controls; Conbraco Industries, Inc.
      c. Crane; Crane Energy Flow Solutions.
      d. Jenkins Valves; Crane Energy Flow Solutions.
      e. Jomar Valve.
      f. KITZ Corporation.
      g. Macomb Groups (The).
      h. Milwaukee Valve Company.
i. NIBCO INC.
j. Red White Valve Corp.
k. Stockham; Crane Energy Flow Solutions.

2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

D. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane; Crane Energy Flow Solutions.
      b. FNW; Ferguson Enterprises, Inc.
      c. Hammond Valve.
      d. Jenkins Valves; Crane Energy Flow Solutions.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. WATTS.
   2. Description:
      a. Standard: MSS SP-80, Type 4.
      b. CWP Rating: 300 psig.
      c. Body Design: Horizontal flow.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: PTFE.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
   B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
   C. Examine threads on valve and mating pipe for form and cleanliness.
D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.

1. Swing Check Valves: In horizontal position with hinge pin level.

F. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:
   a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Grooved-End Copper Tubing: Grooved.
3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 5 and Smaller: Bronze swing check valves with bronze or nonmetallic disc, Class 125 or Class 150, with soldered or threaded end connections.

B. Pipe NPS 2-1/2 and Larger:

1. Bronze swing check valves with bronze or nonmetallic disc, Class 150, with soldered or grooved end connections.

END OF SECTION 22 05 23.14
SECTIO9N 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 22 05 16 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.
1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. B-line, an Eaton business.
   b. Flex-Strut Inc.
   c. G-Strut.
   d. Haydon Corporation.
   e. Thomas & Betts Corporation; A Member of the ABB Group.
   f. Unistrut; Part of Atkore International.
   g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
4. Channels: Continuous slotted carbon-steel or stainless-steel, Type 304 channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
8. Metallic Coating: No coating, plain or hot-dip galvanized where applicable.
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

2.5 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
3. ERICO International Corporation.
5. Pipe Shields Inc.
6. Piping Technology & Products, Inc.
7. Rilco Manufacturing Co., Inc.
8. Value Engineered Products, Inc.
B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   c. MKT Fastening, LLC.
   d. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened Portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. B-line, an Eaton business.
   b. Empire Tool and Manufacturing Co., Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   e. MKT Fastening, LLC.

2. Indoor Applications: Zinc-coated or stainless steel.

2.7 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.
2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.9 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
C. MetalFraming System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


I. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS
   A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
   B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
   C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS
   A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
   B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
   C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
      1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
      2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING
A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING
A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 91 23 "Interior Painting."
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE
A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
G. Use padded hangers for piping that is subject to scratching.
H. Use thermal hanger-shield inserts for insulated piping and tubing.
I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
END OF SECTION 22 05 29
SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.
   3. Stencils.
   4. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.
f. emedco.
g. Kolbi Pipe Marker Co.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Seton Identification Products.

2. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.


5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. 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 proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Carlton Industries, LP.
   d. Champion America.
   e. Craftmark Pipe Markers.
   f. emedco.
   g. Kolbi Pipe Marker Co.
   h. LEM Products Inc.
   i. Marking Services, Inc.
   j. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.


5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

7. 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 proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
4. Carlton Industries, LP.
5. Champion America.
7. emedeo.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Services Inc.
11. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.
2.3 STENCILS

A. Stencils for Piping:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brimar Industries, Inc.
   b. Carlton Industries, LP.
   c. Champion America.
   d. Craftmark Pipe Markers.
   e. Kolbi Pipe Marker Co.
   f. Marking Services Inc.

2. Lettering Size: Size letters according to ASME A13.1 for piping.
3. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
4. Carlton Industries, LP.
5. Champion America.
7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Services Inc.
11. Seton Identification Products.

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 09 91 23 "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.

C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls on both sides of the wall, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 12 feet along each run. Reduce intervals to 3 feet in areas of congested piping and equipment.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule:

1. Low-Pressure Compressed Air Piping:
   a. Background: Safety blue.

2. Domestic Water Piping
   a. Background: Safety green.

3. Sanitary Waste Piping:
   a. Background Color: Safety black.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   c. Low-Pressure Compressed Air: 1-1/2 inches, round.

2. Valve-Tag Colors:
   b. Hot Water: Natural.
   c. Low-Pressure Compressed Air: Natural.
3. Letter Colors:
   c. Low-Pressure Compressed Air: White.

END OF SECTION 22 05 53
SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes insulating the following plumbing piping services:
      1. Domestic cold-water piping.
      2. Domestic hot-water piping.
      3. Domestic recirculating hot-water piping.
      4. Storm-water piping exposed to freezing conditions.
      5. Roof drains and rainwater leaders.
   B. Related Sections:
      1. Section 220716 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
   B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
      1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
      2. Detail attachment and covering of heat tracing inside insulation.
      3. Detail insulation application at pipe expansion joints for each type of insulation.
      4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
      5. Detail removable insulation at piping specialties, equipment connections, and access panels.
      6. Detail application of field-applied jackets.
      7. Detail application at linkages of control devices.
   C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
      1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:
   a. One 10-foot section of NPS 2 straight pipe.
   b. One each of a 90-degree threaded, welded, and flanged elbow.
   c. One each of a threaded, welded, and flanged tee fitting.
   d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
   e. Four support hangers including hanger shield and insert.
   f. One threaded strainer and one flanged strainer with removable portion of insulation.
   g. One threaded reducer and one welded reducer.
   h. One pressure temperature tap.
   i. One mechanical coupling.
2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:


1.6 DELIVERY, STORAGE, AND HANDLING
A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION
A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING
A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. K-Flex USA.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Manson Insulation Inc.
   d. Owens Corning.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Ramco Insulation, Inc.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Ramco Insulation, Inc.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Aeroflex USA, Inc.
      b. Armacell LLC.
      c. Foster Brand; H. B. Fuller Construction Products.
      d. K-Flex USA.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Eagle Bridges - Marathon Industries.
      c. Foster Brand; H. B. Fuller Construction Products.
      d. Mon-Eco Industries, Inc.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow Corning Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. P.I.C. Plastics, Inc.
   d. Speedline Corporation.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Foster Brand; H. B. Fuller Construction Products.
   b. Knauf Insulation.
   c. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Vimasco Corporation.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.

2.6 SEALANTS

A. FSK Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Childers Brand; H. B. Fuller Construction Products.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Foster Brand; H. B. Fuller Construction Products.
   b. Vimasco Corporation.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:


2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Johns Manville; a Berkshire Hathaway company.
   b. P.I.C. Plastics, Inc.
2. Adhesive: As recommended by jacket material manufacturer.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Compac Corporation.
   c. Venture Tape.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division.
   b. Compac Corporation.
   c. Ideal Tape Co., Inc., an American Biltrite Company.
   d. Knauf Insulation.
   e. Venture Tape.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. RPR Products, Inc.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel or Monel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Engineered Brass Company.
   b. Insul-Tect Products Co.
   c. McGuire Manufacturing.
   d. Plumberex Specialty Products, Inc.
   e. Truebro.
   f. Zurn Industries, LLC.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Truebro.
   b. Zurn Industries, LLC.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

   a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099123 "Interior Painting."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of...
flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
   1. NPS 1 and Smaller: Insulation shall be one of the following:
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
   2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
      a. Flexible Elastomeric: 2 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch thick.

B. Domestic Hot and Recirculated Hot Water:
   1. NPS 1 and Smaller: Insulation shall be one of the following:
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
   2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
      a. Flexible Elastomeric: 2 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch thick.

C. Stormwater and Overflow:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 2 inches thick.
D. Roof Drain and Overflow Drain Bodies:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 2 inches thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be the following:

G. Hot Service Drains:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. PVC: 20 mils thick.

D. Piping, Exposed:
   1. PVC: 20 mils thick.

END OF SECTION 22 07 19
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Copper tube and fittings.
      2. Piping joining materials.
      3. Transition fittings.
      4. Dielectric fittings.

1.3 ACTION SUBMITTALS
   A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS
   A. System purging and disinfecting activities report.
   B. Field quality-control reports.

1.5 FIELD CONDITIONS
   A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
      1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of water service.
      2. Do not interrupt water service without Construction Manager's and Owner's written permission.
PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

C. Comply with NSF 372 for low lead.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.


E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

G. Appurtenances for Grooved-End Copper Tubing:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International.
      b. Grinnell Mechanical Products.
      c. Shurjoint Piping Products USA Inc.
      d. Victaulic Company.

   2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75/B 75M copper tube or ASTM B 584 bronze castings.

   3. Mechanical Couplings for Grooved-End Copper Tubing:
      a. Copper-tube dimensions and design similar to AWWA C606.
      b. Ferrous housing sections.
      c. EPDM-rubber gaskets suitable for hot and cold water.
      d. Bolts and nuts.
2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Dresser, Inc.
      c. Ford Meter Box Company, Inc. (The).
      e. JCM Industries, Inc.
      f. Romac Industries, Inc.
      g. Smith-Blair, Inc.
      h. Viking Johnson.
2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. A.Y. McDonald Mfg. Co.
   b. Capitol Manufacturing Company.
   c. Central Plastics Company.
   d. HART Industrial Unions, LLC.
   e. Jomar Valve.
   f. Matco-Norca.
   g. WATTS.
   h. Wilkins.
   i. Zurn Industries, LLC.

3. Pressure Rating: 125 psig minimum at 180 deg F.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Central Plastics Company.
   c. Matco-Norca.
   d. WATTS.
   e. Wilkins.
   f. Zurn Industries, LLC.

3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products.
   c. Matco-Norca.
   d. Precision Plumbing Products.
   e. Victaulic Company.

3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Install pressure gages on suction and discharge piping for each plumbing pump and pressure reducing station. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

P. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   
   b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:
   1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
   2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

2. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

F. Aboveground domestic water piping, NPS 5 to NPS 8, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or resilient wedge gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.


B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 11 16
SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
5. Balancing valves.
7. Strainers.
8. Outlet boxes.
9. Hose bibbs.
10. Wall hydrants.
11. Drain valves.
13. Air vents.
15. Trap-seal primer systems.
17. Flexible connectors.

B. Related Requirements:

1. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
3. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.
1.4 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES
   A. Potable-water piping and components shall comply with NSF 61 and NSF 14.
   B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS
   A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS
   A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Ames Fire & Waterworks; A WATTS Brand.
         b. Apollo Flow Controls; Conbraco Industries, Inc.
         c. Cash Acme, A Division of Reliance Worldwide Corporation.
         d. FEBCO; A WATTS Brand.
         e. Rain Bird Corporation.
         f. Toro Company (The).
         g. WATTS.
         h. Zurn Industries, LLC.
      3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
      5. Inlet and Outlet Connections: Threaded.
      6. Finish: Chrome plated.
B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Arrowhead Brass Products.
c. Cash Acme, A Division of Reliance Worldwide Corporation.
d. Legend Valve & Fitting, Inc.
e. MIFAB, Inc.
f. Prier Products, Inc.
g. WATTS.
h. Woodford Manufacturing Company.
i. Zurn Industries, LLC.

5. Finish: Chrome or nickel plated.

C. Laboratory-Faucet Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. Apollo Flow Controls; Conbraco Industries, Inc.
b. WATTS.
c. Woodford Manufacturing Company.
d. Zurn Industries, LLC.

5. End Connections: Threaded.
6. Finish: Chrome plated.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. Ames Fire & Waterworks; A WATTS Brand.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. FEBCO; A WATTS Brand.
d. Flomatic Corporation.
e. WATTS.
f. Zurn Industries, LLC.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: Refer to schedule.
5. Size: Refer to schedule.
6. Design Flow Rate: Refer to schedule.
7. Pressure Loss at Design Flow Rate: Refer to schedule.
8. Body: Bronze for NPS 2 and smaller; ductile iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
   d. Pre-wired flood control valve to shut off water supply in the event of a catastrophically fouled Reduced-Pressure Principle Backflow Preventer when the relief port discharges constant for 2 minutes. This valve should only be installed at the building water service entrance.

B. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FEBCO; A WATTS Brand.
   c. Flomatic Corporation.
   d. WATTS.
   e. Zurn Industries, LLC.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Cash Acme; a division of Reliance Worldwide Corporation.
   c. Honeywell.
   d. WATTS.
   e. Zurn Industries, LLC.

4. Size: 4 NPS.
5. Design Flow Rate: 150 gpm.
6. Design Inlet Pressure: 130 psig.
8. Body: Cast iron with interior lining that complies with AWWA C550, NSF 61, NSF 372, and that is FDA approved for NPS 2-1/2 and NPS 4.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Flo Fab Inc.
   c. ITT Corporation.
   d. NIBCO INC.
   e. Schneider Electric USA, Inc.
   f. TACO Comfort Solutions, Inc.
   g. WATTS.

2. Type: Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

C. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Crane; Crane Energy Flow Solutions.
   c. Hammond Valve.
   d. Jenkins Valves; Crane Energy Flow Solutions.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Red-White Valve Corp.
   h. Stockham; Crane Energy Flow Solutions.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. Cash Acme, A Division of Reliance Worldwide Corporation.
   d. Chicago Faucets
   e. Honeywell.
   f. Lawler Manufacturing Company, Inc.
   g. Leonard Valve Company.
   h. POWERS; A WATTS Brand.
   i. WATTS.
   j. Zurn Industries, LLC.

2. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 110 deg F.
9. Tempered-Water Design Flow Rate: 3.2 gpm. Minimum flow shall be 0.25 gpm.

2.8 STRainers FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; ductile with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.020 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
   c. Strainers NPS 5 and Larger: 0.10 inch.
2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Guy Gray Manufacturing Co., Inc.
   c. IPS Corporation.
   d. LSP Products Group, Inc.
   e. Oatey.
   f. Plastic Oddities.
   g. Symmons Industries, Inc.
   h. WATTS.
   i. Whitehall Manufacturing.
   j. Zurn Industries, LLC.

4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 1-1/2 standpipe and P-trap for direct waste connection to drainage piping.
8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. IPS Corporation.
   c. LSP Products Group, Inc.
   d. Oatey.
   e. Plastic Oddities.

4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 ball valve and NPS 1/2 copper, water tubing.
2.10 HOSE BIBBS

A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Josam Company.
   c. MIFAB, Inc.
   d. Prier Products, Inc.
   e. Tyler Pipe; a subsidiary of McWane Inc.
   f. WATTS.
   g. Woodford Manufacturing Company.
   h. Zurn Industries, LLC.

2. Standard: ASME A112.18.1 for sediment faucets.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.11 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Josam Company.
   c. MIFAB, Inc.
   d. Prier Products, Inc.
   e. Tyler Pipe; a subsidiary of McWane Inc.
   f. WATTS.
   g. Woodford Manufacturing Company.
   h. Zurn Industries, LLC.

4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
11. Operating Keys(s): One with each wall hydrant.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

2. Pressure Rating: 400-psi minimum CWP.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
8. Inlet: Threaded or solder joint.

2.13 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   c. Josam Company.
   d. MIFAB, Inc.
   e. Precision Plumbing Products.
   f. Sioux Chief Manufacturing Company, Inc.
   g. Tyler Pipe; a subsidiary of McWane Inc.
   h. WATTS.
   i. Zurn Industries, LLC.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.
2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. Precision Plumbing Products.
   d. Sioux Chief Manufacturing Company, Inc.
   e. WATTS.
   f. Zurn Industries, LLC.

5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Balancing Valves: Install in locations where they can easily be adjusted.

D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Y-Pattern Strainers: For water, install on supply side of each water pressure-reducing valve and pump.
F. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061053 "Miscellaneous Rough Carpentry."

G. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.

H. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

C. Comply with requirements for grounding equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Reduced-pressure-principle backflow preventers.
2. Water pressure-reducing valves.
3. Calibrated balancing valves.
4. Primary, thermostatic, water mixing valves.
6. Primary water tempering valves.
7. Outlet boxes.
8. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 22 11 19
SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   2. Hubless, cast-iron soil pipe and fittings.
   3. Specialty pipe fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For hub-and-spigot, hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:


2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ANACO-Husky.
   b. Charlotte Pipe and Foundry Company.
   c. Clamp-All Corp.
   e. MIFAB, Inc.
   f. Mission Rubber Company, LLC; a division of MCP Industries.
   g. NewAge Casting.
   h. Stant.
   i. Tyler Pipe; a subsidiary of McWane Inc.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. Copper Pressure Fittings:
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Shielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      2) Mission Rubber Company, LLC; a division of MCP Industries.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:
1. Dielectric Unions:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) A.Y. McDonald Mfg. Co.
      2) Capitol Manufacturing Company.
      3) Central Plastics Company.
      4) HART Industrial Unions, LLC.
      5) Jomar Valve.
      6) Matco-Norca.
      7) WATTS.
SANITARY WASTE AND VENT PIPING

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
   1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
   2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
      a. Straight tees, elbows, and crosses may be used on vent lines.
   3. Do not change direction of flow more than 90 degrees.
   4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of waste piping in direction of flow is prohibited.

J. Lay buried building waste piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Install engineered soil and waste and vent piping systems as follows:
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

O. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
   a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
   b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary waste gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION
A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
   1. Cut threads full and clean using sharp dies.
   2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
      b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
      c. Do not use pipe sections that have cracked or open welds.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls.
   Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.
   6. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:
   1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION
A. Identify exposed sanitary waste and vent piping.
B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL
A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
      a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
      a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
      b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
   a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
   b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
   c. Air pressure must remain constant without introducing additional air throughout period of inspection.
   d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9 PIPING SCHEDULE

A. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
   2. Copper Type DWV tube, copper drainage fittings, and soldered joints.

B. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

C. Aboveground, vent piping shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Cleanouts.
      2. Through-penetration firestop assemblies.
   B. Related Requirements:
      1. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1.4 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.
PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. MIFAB, Inc.
   d. Tyler Pipe; a subsidiary of McWane Inc.
   e. WATTS.
   f. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. Oatey.
   d. Sioux Chief Manufacturing Company, Inc.
   e. Tyler Pipe; a subsidiary of McWane Inc.
   f. WATTS.
   g. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
7. Outlet Connection: Inside calk, Spigot or Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron or Plastic with threads.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Extra Heavy Duty.
13. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. MIFAB, Inc.
   d. Tyler Pipe; a subsidiary of McWane Inc.
   e. WATTS.
   f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass.
   b. Countersunk head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ProSet Systems Inc.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2: 4-inch-minimum water seal.
      b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

F. Expansion Joints:
   2. Body: Cast iron with bronze sleeve, packing, and gland.
   3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Assemble open drain fittings and install with top of hub 1 inch above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection or if drain is equipped with a waterless trap seal device.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

K. Install wood-blocking reinforcement for wall-mounting-type specialties.
L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

D. Set flashing on floors in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.
SECTION 22 13 19.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Floor drains.

1.3 DEFINITIONS
   A. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES
   A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
   B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS
   A. Cast-Iron Floor Drains FD-1:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         c. Josam Company.
         d. MIFAB, Inc.
e. Prier Products, Inc.
f. Sioux Chief Manufacturing Company, Inc.
g. Wade; a subsidiary of McWane Inc.
h. WATTS.
i. Zurn Industries, LLC.

2. Standard: ASME A112.6.3.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
14. Top Shape: Round or Square. Only use square in tiled areas.
15. Top Loading Classification: Medium Duty.
16. Funnel: Not required.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
18. Trap Material: Cast iron.
20. Drain Features: Waterless trap seal device.

B. Heavy Duty Cast-Iron Floor Drains FD-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   c. Josam Company.
   d. MIFAB, Inc.
   e. Prier Products, Inc.
   f. Sioux Chief Manufacturing Company, Inc.
   g. Wade; a subsidiary of McWane Inc.
   h. WATTS.
   i. Zurn Industries, LLC.

2. Standard: ASME A112.6.3.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
11. Sediment Bucket: Required.
12. Top or Strainer Material: Nickel bronze.
14. Top Shape: Round.
15. Top Loading Classification: Medium Duty.
16. Funnel: Not required.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
18. Trap Material: Cast iron.
20. Drain Features: Waterless trap seal device.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
   a. Maintain integrity of waterproof membranes where penetrated.
5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

B. Install trench drains at low points of surface areas to be drained.

1. Set grates of drains flush with finished surface, unless otherwise indicated.

C. Install open drain fittings with top of hub 1 inch above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19.13
SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Hubless, cast-iron soil pipe and fittings.
   2. Specialty pipe and fittings.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For controlled-flow roof drainage system. Include calculations, plans, and details.

1.4 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which drainage piping will be attached or suspended from.
B. Field quality-control reports.

1.5 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standard: ASTM A 888 or CISPI 301.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ANACO-Husky.
   b. Charlotte Pipe and Foundry Company.
   c. Clamp-All Corp.
   e. Ideal Clamp Products, Inc.
   f. MIFAB, Inc.
   g. Mission Rubber Company, LLC; a division of MCP Industries.
   h. NewAge Casting.
   i. Stant.
   j. Tyler Pipe; a subsidiary of McWane Inc.

2. Standard: ASTM C 1540..
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Shielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2) Mission Rubber Company, LLC; a division of MCP Industries.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   2. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.
I. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
   1. Do not change direction of flow more than 90 degrees.
   2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

K. Install piping at the following minimum slopes unless otherwise indicated:
   1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

M. Install engineered controlled-flow drain specialties and storm drainage piping in locations indicated.

N. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
   2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
3.2 JOINT CONSTRUCTION


B. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

C. Joint Restraints and Sway Bracing:
   1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
      a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
      b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
      c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. Base of Vertical Piping: MSS Type 52, spring hangers.
B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
   a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.
3. Test Procedure:
   a. Test storm drainage piping on completion of roughing-in.
   b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.
3.9 PIPING SCHEDULE

A. Aboveground storm drainage piping NPS 6 and smaller shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.

B. Aboveground, storm drainage piping NPS 8 and larger shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.

END OF SECTION 22 14 13
SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cleanouts.

B. Related Requirements:
   1. Section 07 62 00 "Sheet Metal Flashing and Trim" for penetrations of roofs.
   2. Section 07 84 13 "Penetration Firestopping" for firestopping roof penetrations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Josam Company.
      c. MIFAB, Inc.
      d. Tyler Pipe; a subsidiary of McWane Inc.
      e. Wade; a subsidiary of McWane Inc.
f. WATTS.
g. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body Material: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. Oatey.
   d. Sioux Chief Manufacturing Company, Inc.
   e. Tyler Pipe; a subsidiary of McWane Inc.
   f. Wade; a subsidiary of McWane Inc.
   g. WATTS.
   h. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Hub with inside caulk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
11. Frame and Cover Shape: Round.
13. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. MIFAB, Inc.
   d. Tyler Pipe; a subsidiary of McWane Inc.
   e. Wade; a subsidiary of McWane Inc.
   f. WATTS.
   g. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass.
   b. Countersunk head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as, or not more than, one size smaller than cleanout size.

D. Test Tees:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. MIFAB, Inc.
   d. Tyler Pipe; a subsidiary of McWane Inc.
   e. WATTS.
   f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk, brass.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
   1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
   3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate cleanouts at base of each vertical storm piping conductor.
B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install test tees in vertical conductors and near floor.

E. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

F. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestoping."

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23
SECTION 22 15 13 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems:

1. Pipes, tubes, and fittings.
2. Joining materials.
3. Valves.
4. Dielectric fittings.
5. Specialties.
6. Quick couplings.
7. Hose assemblies.

B. Related Sections include the following:

1. Section 22 15 19 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

D. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Plastic pipes, fittings, and valves.
2. Dielectric fittings.
4. Pressure regulators. Include rated capacities and operating characteristics.
5. Automatic drain valves.
6. Filters. Include rated capacities and operating characteristics.
7. Lubricators. Include rated capacities and operating characteristics.
8. Quick couplings.
9. Hose assemblies.

1.5 INFORMATIONAL SUBMITTALS
A. Welding certificates.
B. Qualification Data: For installers.
C. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE
A. Installer Qualifications:
   1. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.
B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
C. ASME Compliance:

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS
A. Schedule 40, Steel Pipe: ASTM A53/A53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.
4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
7. Grooved-End Fittings and Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Anvil International.
      2) Grinnell G-Fire by Johnson Controls Company.
      3) Star Pipe Products.
      4) Victaulic Company.
      5) Ward Manufacturing, Inc.
8. Grooved-End Fittings: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron casting; with grooves according to AWWA C606 and dimensions matching steel pipe.
9. Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for 300-psig minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gaskets for oil-free compressed air. Provide NBR gaskets if compressed air contains oil or oil vapor.

B. Copper Tube: ASTM B88, Type M seamless, drawn-temper, water tube.
   1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for soldered joints.
   2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
   3. Copper Unions: ASME B16.22 or MSS SP-123.
   4. Press-Type Fittings, NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) Apollo Flow Controls; Conbraco Industries, Inc.
         2) Elkhart Products Corporation.
         3) Viega LLC.

2.2 JOINING MATERIALS
A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.


2.3 VALVES

A. Steel Ball Valves with Full Port, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FNW; Ferguson Enterprises, Inc.
   c. Jamesbury; Metso.
   d. NIBCO INC.

2. Description:
   d. Body Material: Carbon steel, ASTM A216, Type WCB.
   e. Ends: Flanged or threaded.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A.Y. McDonald Mfg. Co.
b. Capitol Manufacturing Company.
c. Central Plastics Company.
d. HART Industrial Unions, LLC.
e. Jomar Valve.
f. Matco-Norca.
g. Viega LLC.
h. WATTS.
i. Wilkins.

2. Description:
   b. Pressure Rating: 250 psig.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. Central Plastics Company.
   c. Matco-Norca.
   d. Viega LLC.
   e. WATTS.
   f. Wilkins.

2. Description:
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 300 psig.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Description:
   a. Nonconductor materials for field assembly of companion flanges.
b. Pressure Rating: 250 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

2.5 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Diaphragm or pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

D. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.

E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.

F. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.

1. Provide with automatic feed device for supplying oil to lubricator.

2.6 QUICK COUPLINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Aeroquip Corporation.
2. Bowes Manufacturing Inc.
3. Foster Manufacturing, Inc.
5. Parker Hannifin Corp.
6. Rectus Corp.
8. TOMCO Products Inc.

B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
   1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

D. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
   1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
   2. Plug End: With barbed outlet for attaching hose.

2.7 HOSE ASSEMBLIES

A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
   2. Hose Clamps: Stainless-steel clamps or bands.
   3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
   4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

2.8 HOSE REELS

A. Refer to schedules on drawings for details.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.

B. Drain Piping: Use the following piping materials:

1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and soldered joints.

3.2 VALVE APPLICATIONS

A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Articles in Section 22 05 23.12 "Ball Valves for Plumbing Piping," according to the following:

1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
2. Grooved-end valves may be used with grooved-end piping and grooved joints.

3.3 PIPING INSTALLATION, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.
2. Use cast-copper-alloy companion flange with gasket and soldered joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.
J. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

L. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 22 05 19 "Meters and Gages for Plumbing Piping."

M. Install piping to permit valve servicing.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.

E. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
G. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.

H. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.

I. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

D. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

E. Locate valves for easy access and provide separate support where necessary.

F. Install valves in horizontal piping with stem at or above center of pipe.

G. Install valves in position to allow full stem movement.

H. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

3.7 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressors.

C. Install air-line pressure regulators in branch piping to equipment and tools.

D. Install automatic drain valves on receivers. Discharge condensate onto nearest floor drain.
E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated.

F. Install quick couplings at piping terminals for hose connections.

G. Install hose assemblies at hose connections.

3.8 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

3.9 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

B. Vertical Piping: MSS Type 8 or 42, clamps.

C. Individual, Straight, Horizontal Piping Runs:
   1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
   2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

E. Base of Vertical Piping: MSS Type 52, spring hangers.

F. Support horizontal piping within 12 inches of each fitting and coupling.

G. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

H. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
   2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
   3. NPS 1-1/2: 12 feet with 3/8-inch rod.
   4. NPS 2: 13 feet with 3/8-inch rod.

I. Install supports for vertical, Schedule 40, steel piping every 15 feet.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1/4: 60 inches with 3/8-inch rod.
   2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

3.10 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters, lubricators, and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 22 15 13
SECTION 22 15 19 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

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. Lubricated, reciprocating air compressors.

1.3 DEFINITIONS

   A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

   B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.4 ACTION SUBMITTALS

   A. Product Data: For each type of product.

      1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

   B. Shop Drawings:

      1. Include diagrams for power, signal, and control wiring.

   C. Delegated-Design Submittal: For compressed-air equipment mounting.

      1. Detail fabrication and assembly of supports.
      2. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.5 CLOSEOUT SUBMITTALS

   A. Operation and Maintenance Data: For compressed-air equipment to include in emergency, operation, and maintenance manuals.
1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Air-Compressor, Inlet-Air-Filter Elements: Equal to 10 percent of amount installed, but no fewer than 5 units.
2. Belts: Two for each belt-driven compressor.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design compressed-air equipment mounting.

2.3 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS

A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
3. Control Voltage: 120-V ac or less, using integral control power transformer.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
2. Interior Finish: Corrosion-resistant coating.
3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.

2.4 LUBRICATED, RECIPROCATING AIR COMPRESSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

2. CompAir, Ltd.
3. Curtis-Toledo.
5. General Air Products, Inc.
6. Ingersoll-Rand.
7. Kaeser Compressors, Inc.
8. Powerex, Inc.
9. Quincy Compressor.
10. Saylor-Beall Manufacturing Company.
11. Emax

B. Compressor(s): Lubricated, reciprocating-piston type with lubricated compression chamber and crankcase.

1. Submerged gear-type oil pump.
2. Oil filter.
3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
4. Belt guard totally enclosing pulleys and belts.

C. Capacities and Characteristics:

1. Refer to schedules on drawings.
3. Motor (Each Air Compressor):
4. Electrical Characteristics:
   a. Refer to schedules on drawings.
   b.
5. Receiver: ASME construction steel tank.
b. Capacity: 120 gal.
c. Interior Finish: Epoxy coating.
d. Pressure Rating: 175 psig minimum.
e. Pressure Regulator Setting: 90 psig.
f. Pressure Relief Valve Setting: 100 psig.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Equipment Mounting:

1. Install air compressors on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Install compressed-air equipment anchored to substrate.

C. Arrange equipment so controls and devices are accessible for servicing.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 15 13 "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
B. Where installing piping adjacent to machine, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Identify general-service air compressors and components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check for lubricating oil in lubricated-type equipment.
   3. Check belt drives for proper tension.
   4. Verify that air-compressor inlet filters and piping are clear.
   5. Check for equipment vibration-control supports and flexible pipe connectors, and verify that equipment is properly attached to substrate.
   6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
   7. Drain receiver tanks.
   8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   9. Test and adjust controls and safeties.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors.

END OF SECTION 22 15 19
SECTION 22 42 13.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall-mounted water closets.
   2. Flushometer valves.
   3. Toilet seats.
   4. Supports.

1.2 DEFINITIONS

A. Standard-Efficiency Flush Volume: 1.6 gal. per flush.

B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.

C. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than four of each type.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
5. Comply with ASME A112.6.1M for water-closet supports.
7. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
8. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 WALL-MOUNTED WATER CLOSETS

A. Water Closets - Wall Mounted, Top Spud: P-1

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. Advanced Modern Technologies Corporation - AMTC.
c. Briggs Plumbing Products, Inc.
d. Gerber Plumbing Fixtures LLC.
e. Kohler Co.
f. Mansfield Plumbing Products LLC.
g. Peerless Pottery Sales, Inc.
h. Sloan Valve Company.
i. TOTO USA, INC.
j. Zurn Industries, LLC.

2. Source Limitations: Obtain water closets from single source from single manufacturer.
3. Bowl:
   
b. Type: Siphon jet.
c. Style: Flushometer valve.
d. Mounting Height: ADA compliant.
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Spud Size and Location: NPS 1-1/2; top.
h. Color: White.
6. Support: Water-closet carrier

2.3 FLUSHOMETER VALVES


1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Delany Products.
   b. I-Con Systems, Inc.
   c. Sloan Valve Company.
   d. Zurn Industries, LLC.

2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome-plated.
8. Actuator: Side or top mounted; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
9. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
10. Consumption: 1.28 gal. per flush.

2.4 TOILET SEATS

A. Toilet Seats: Seat.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. Bemis Manufacturing Company.
   c. Centoco Manufacturing Corporation.
   d. Church Seats; Bemis Manufacturing Company.
   e. Jones Stephens Corp.
   f. Kohler Co.
   g. TOTO USA, INC.
   h. Zurn Industries, LLC.
2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
8. Seat Cover: Not required.
10. Surface Treatment: Antimicrobial.

2.5 SUPPORTS

A. Water-Closet Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. Josam Company.
   c. MIFAB, Inc.
   d. Wade Drains.
   e. WATTS.
   f. Zurn Industries, LLC.

2. Source Limitations: Obtain water-closet carrier from single source from single manufacturer.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:
1. Install level and plumb.
2. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:
   1. Use carrier supports with waste-fitting assembly and seal.
   2. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
   3. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:
   1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
   2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   3. Install actuators in locations easily reachable for people with disabilities.
   4. Install new batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:
   1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
   2. Install deep-pattern escutcheons if required to conceal protruding fittings.
   3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Joint Sealing:
   1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
   2. Match sealant color to water-closet color.
   3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.
3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 13.13
SECTION 22 42 16.13 - COMMERCIAL LAVATORIES

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. Vitreous-china, wall-mounted lavatories.
2. Automatically operated lavatory faucets.
5. Lavatory supports.

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 lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
   a. Servicing and adjustments of automatic faucets.

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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Vitreous China, Wall Mounted, with Back P-2:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. Briggs Plumbing Products, Inc.
   c. Gerber Plumbing Fixtures LLC.
   d. Kohler Co.
   e. Mansfield Plumbing Products LLC.
   f. Peerless Pottery Sales, Inc.
   g. Sloan Valve Company.
   h. Zurn Industries, LLC.

2. Fixture:
   b. Type: For wall hanging.
   c. Nominal Size: Rectangular, 20 by 18 inches.
   d. Faucet-Hole Punching: One hole.
   e. Faucet-Hole Location: Top.
   g. Mounting Material: Chair carrier.

3. Faucet: Lavatory Sensor Faucet
5. Lavatory Mounting Height: Handicapped/elderly in accordance with ICC A117.1.

2.2 AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
B. Lavatory Faucets - Automatic Type: Battery Powered Electronic Sensor Operated, Nonmixing, Lavatory Sensor Faucet:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Advanced Modern Technologies Corporation - AMTC.
   c. Bradley Corporation.
   d. Chicago Faucets; Geberit Company.
   e. Dyson Inc.
   f. Gerber Plumbing Fixtures LLC.
   g. GROHE America, Inc.
   h. Hydrotek International, Inc.
   i. Kohler Co.
   j. Krowne.
   k. Moen Incorporated.
   l. Sloan Valve Company.
   m. Speakman Company.
   n. Stern Engineering Ltd.
   o. T&S Brass and Bronze Works, Inc.
   p. TOTO USA, INC.
   q. Zurn Industries, LLC.

3. 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.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Single hole.
6. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 0.35 gpm.
10. Spout: Rigid type.
11. Spout Outlet: Laminar flow.
12. Drain: Not part of faucet.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.
C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:
   2. ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:
   2. Material:
      a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

2.5 LAVATORY SUPPORTS

A. Lavatory Carrier:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      b. Josam Company.
      c. MIFAB, Inc.
      d. Wade; a subsidiary of McWane Inc.
      e. WATTS.
      f. Zurn Industries, LLC.
   2. Standard: ASME A112.6.1M.
3.1 EXAMINATION
   A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
   A. Install lavatories level and plumb in accordance with roughing-in drawings.
   B. Install supports, affixed to building substrate, for wall-mounted lavatories.
   C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
   D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
   E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
   F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS
   A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
   B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
   C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING
   A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
   B. Install new batteries in battery-powered, electronic-sensor mechanisms.
3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.13
SECTION 22 42 16.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Service sinks.
      2. Classroom/Plaster sinks.
      3. Manually operated sink faucets.
      4. Supply fittings.
      5. Waste fittings.

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 sinks.
      2. Include rated capacities, operating characteristics and furnished specialties and
         accessories.

1.4 INFORMATIONAL SUBMITTALS
   A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance
      manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective
      covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks - Terrazzo, Floor Mounted: P-3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Acorn Engineering Company; a Division of Morris Group International.
   b. Fiat Products.
   c. Florestone Products Co., Inc.
   d. Krowne.
   e. Stern-Williams Co., Inc.

2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
   a. Material: Marble chips cast in portland cement to produce a compressive strength of not less than 3000 psi, seven days after casting.
   b. Shape: Square.
   c. Nominal Size: 32 by 32 inches.
   d. Height: 12 inches with dropped front.
   e. Tiling Flange: Not required.
   f. Rim Guard: On all top surfaces.
   g. Color: Black & White.
   h. Drain: Grid with NPS 3 outlet.

4. Mounting: On floor and flush to wall.
5. Faucet: Service Sink Faucet.

2.2 KITCHEN/UTILITY SINKS

A. Classroom Sinks - Stainless Steel, Counter Mounted: P-4.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Advance Tabco.
   b. Eagle Group.
c. Elkay.
d. Franke.
e. Just Manufacturing.

2. Source Limitations: Obtain sinks from single source from single manufacturer.

3. Fixture:
   b. Type: Stainless steel, undermount, sound-deadened unit.
   c. Number of Compartments: One.
   e. Material: 18 gauge, Type 304 stainless steel.
   f. Compartment:
      2) Drain: Grid with NPS 1-1/2 tailpiece.
      3) Drain Location: Near back of compartment.
      4) Depth: Wheelchair accessible.

4. Faucet(s): P-4 P-5 Faucet.
   a. Number Required: One.

5. Supply Fittings:
   b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      1) Operation: Loose key.
      2) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

6. Waste Fittings:
   b. Trap(s):
      1) Size: NPS 1-1/2.
      2) Material:
         a) Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.

7. Mounting: Undermount with sealant.

B. Classroom Sinks - Stainless Steel, Counter Mounted: P-5.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Advance Tabco.
   b. Eagle Group.
   c. Elkay.
   d. Franke.
   e. Just Manufacturing.

2. Source Limitations: Obtain sinks from single source from single manufacturer.

3. Fixture:
   b. Type: Stainless steel, undermount, sound-deadened unit.
   c. Number of Compartments: One.
   e. Material: 18 gauge, Type 304 stainless steel.
      2) Drain: Grid with NPS 1-1/2 tailpiece.
      3) Drain Location: Near back of compartment.
      4) Depth: Wheelchair accessible.

4. Faucet(s): P-4 P-5 Faucet.
   a. Number Required: One.

5. Supply Fittings:
   b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      1) Operation: Loose key.
      2) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

6. Waste Fittings:
   b. Trap(s):
      1) Size: Plaster trap.

7. Mounting: Undermount with sealant.

C. Plaster Sinks - Stainless Steel, Counter Mounted: P-6
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Advance Tabco.
   b. Eagle Group.
   c. Elkay.
   d. Franke.
   e. Just Manufacturing.

2. Source Limitations: Obtain sinks from single source from single manufacturer.

3. Fixture:
   b. Type: Stainless steel, self-rimming, sound-deadened unit less ledge back.
   c. Number of Compartments: One.
   d. Overall Dimensions: 25 inches x 21 inches x 12 inches.
   e. Material: 16 gauge, Type 304 stainless steel.
      1) Dimensions: 22 inches x 16 inches x 12 inches.
      2) Drain: Grid with NPS 1-1/2 tailpiece.
      3) Drain Location: Centered in compartment.
      4) Depth: Standard.

4. Faucet(s): P-6 Faucet.
   a. Number Required: One.

5. Supply Fittings:
   b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      1) Operation: Loose key.
      2) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

6. Waste Fittings:
   b. Trap(s):
      1) Size: Plaster trap.

7. Mounting: On counter with sealant.
2.3 MANUALLY OPERATED SINK FAUCETS

A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

A. Service Sink Faucets - Manual Type: Two-handle mixing, Service Sink Faucet

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Central Brass Company; a Pioneer Industries, Inc. brand.
   c. Chicago Faucets; Geberit Company.
   d. Elkay.
   e. Gerber Plumbing Fixtures LLC.
   f. Just Manufacturing.
   g. Kohler Co.
   h. Speakman Company.
   i. T&S Brass and Bronze Works, Inc.
   j. Wolverine Brass, Inc.
   k. Zurn Industries, LLC.

2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Widespread.
6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Chrome plated.
8. Maximum Flow Rate: unrestricted.
9. Mounting Type: Wall, exposed.
10. Valve Handle(s): Cross, four arm.
11. Spout Type: Rigid with wall brace.
13. Spout Outlet: Hose thread in accordance with ASME B1.20.7.

B. Commercial Sink Faucets - Manual Type: Two-handle mixing, P-4 P-5 Faucet

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Central Brass Company; a Pioneer Industries, Inc. brand.
   c. Chicago Faucets; Geberit Company.
2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Widespread.
6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Chrome plated.
8. Maximum Flow Rate: 0.5 gpm.
9. Mounting Type: Deck, exposed.
10. Valve Handle(s): 4-inch wrist blade.
11. Spout Type: Swivel gooseneck.

C. Commercial Sink Faucets - Manual Type: Two-handle mixing Spray valve, P-6 Faucet

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Central Brass Company; a Pioneer Industries, Inc. brand.
   c. Chicago Faucets; Geberit Company.
   d. Elkay.
   e. Gerber Plumbing Fixtures LLC.
   f. Just Manufacturing.
   g. Kohler Co.
   h. Speakman Company.
   i. T&S Brass and Bronze Works, Inc.
   j. Wolverine Brass, Inc.
   k. Zurn Industries, LLC.

2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Widespread.
6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Chrome plated.
8. Maximum Flow Rate: 2.2 gpm.
9. Mounting Type: Deck, exposed.
10. Valve Handle(s): 4-inch wrist blade.
11. Spout Type: Swivel gooseneck.
14. Spray Valve Unit:
   a. Style: Flexible hose.
   b. Hose: 84-inch flexible stainless steel with heat-resistant handle.
   c. Spray valve: Grip Handle.

2.4 GROUT
B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 5000 psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install sinks level and plumb in accordance with rough-in drawings.
B. Set floor-mounted sinks in leveling bed of cement grout.
C. Install water-supply piping with stop on each supply to each sink faucet.
   1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
   2. Install stops in locations where they can be easily reached for operation.
D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.16
SECTION 22 45 00 - EMERGENCY PLUMBING FIXTURES

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. Hand-held eye/face wash equipment
      2. Water-tempering equipment.

1.3 DEFINITIONS
   A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
   B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
   C. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS
   A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
   B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.
1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.


PART 2 - PRODUCTS

2.1 EYE/FACE WASH EQUIPMENT

A. Hand-Held, Wall-Mounted, Plumbed, Eye/Face Wash Units, P-9:

1. Capacity: Not less than 3.0 gpm for at least 15 minutes.
2. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
3. Control-Valve Actuator: Forged brass squeeze valve activated by stainless steel lever handle. Valve has replaceable stainless steel seat for exceptional durability. Locking clip engages when handle is depressed, providing “hands free” operation. Valve stays open until locking clip is released.
4. Spray-Head Assembly: Two spray heads mounted side-by-side. Each head has a “flip top” dust cover, internal flow control and filter to remove impurities from the water flow.
5. Hose: 12' reinforced nylon retractable coiled hose. 180 PSI maximum rated working pressure.
6. Mounting: Bracket with spring clips to hold unit on wall. Clips position spray heads and handle to face forward at all times.

2.2 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Safety.
b. Armstrong International, Inc.
c. Bradley Corporation.
d. Encon Safety Products.
e. Guardian Equipment Co.
f. Haws Corporation.
g. Lawler Manufacturing Company, Inc.
h. Leonard Valve Company.
i. POWERS; A WATTS Brand.
j. Speakman Company.

2. Description: Factory-fabricated equipment with thermostatic mixing valve.
   a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure. Mixing valve must be ASSE 1071 listed.
   b. Supply Connections: For hot and cold water.

2.3 SOURCE QUALITY CONTROL
   A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION
   A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
   B. Install fixtures level and plumb.
   C. Fasten fixtures to substrate.
   D. Install shutoff valves in water-supply piping to fixtures. Use ball valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping."
1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116 "Domestic Water Piping."

B. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 22 45 00
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 22 47 16 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes pressure water coolers and related components.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of pressure water cooler.
      1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
      2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For pressure water coolers 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. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 5 of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS
   A. Pressure Water Coolers, P-7: Wall mounted, bi-level ADA, with bottle filler.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Manufacturing Co., EZSTLG8WSSK.

2. Standards:
   a. Comply with NSF 61 Annex G.
   b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

3. Cabinet: Bi-level with two attached cabinets, vinyl-covered steel with stainless-steel top.
4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
9. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
10. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
   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.

11. Bottle filling station with counter to display bottles saved.
12. Capacities and Characteristics:
   b. Ambient-Air Temperature: 90 deg F.
   c. Inlet-Water Temperature: 80 deg F.
   d. Cooled-Water Temperature: 50 deg F.
   e. Electrical Characteristics:
      1) Volts: 115-V ac.
      2) Phase: Single.
      3) Hertz: 60.
      4) Full-Load Amperes: 6.0.


2.2 SUPPORTS

A. Type I Water Cooler Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings.

B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 47 16
SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION
A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS
A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS
A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS
A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Premium efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.
D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.


F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Grout.
   3. Silicone sealants.

B. Related Requirements:
   1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40,, with plain ends and integral welded waterstop collar.

C. Galvanized-Steel Sheet Pipe Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches finished floor level.

2. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at
pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs Above Grade:
   a. Piping Smaller Than NPS 6 Steel-pipe sleeves

2. Interior Partitions:
   a. Piping Smaller Than NPS 6 : Galvanized-steel pipe sleeves

END OF SECTION 23 05 17
ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Escutcheons.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
      b. Chrome-Plated Piping: One-piece steel or split-plate steel with polished, chrome-plated finish.
      c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

2. Escutcheons for Existing Piping to Remain:
   a. Chrome-Plated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL
   A. Using new materials, replace broken and damaged escutcheons.

END OF SECTION 23 05 18
SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

2. Case: Plastic 7-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F
6. Window: plastic
7. Stem: Aluminum, brass, or stainless steel and of length to suit installation.

b. Design for Thermowell Installation: Bare stem.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
3. Material for Use with Copper Tubing: CNR
4. Material for Use with Steel Piping: CRES
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin

2.3 DIAL-TYPE PRESSURE GAGES

A. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

2. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi
8. Window: plastic.
9. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install valve and snubber in piping for each pressure gage for fluids (except steam).

G. Install test plugs in piping tees.

H. Install flow indicators in piping systems in accessible positions for easy viewing.

I. Install connection fittings in accessible locations for attachment to portable indicators.

J. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Inlet and outlet of each hydronic coil in air-handling units.

K. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be the following:
1. Direct-mounted, plastic-case, vapor-actuated type.

B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
   1. Direct-mounted, plastic-case, vapor-actuated type.

C. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
   1. Direct-mounted, plastic-case, vapor-actuated type.

D. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be the following:
   1. Sealed, direct-mounted, plastic case.

B. Pressure gages at suction and discharge of each pump shall be the following:
   1. Sealed, direct-mounted, plastic case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi

END OF SECTION 23 05 19
SECTION 23 05 23.12 - BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Brass ball valves.
   2. Bronze ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   5. ASME B16.18 for cast copper solder-joint connections.
   7. ASME B16.34 for flanged and threaded end connections.
   8. ASME B31.1 for power piping valves.
   9. ASME B31.9 for building services piping valves.

B. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valve Actuator Types:

F. Valves in Insulated Piping:
1. Provide 2-inch extended neck stems.
2. Extended operating handles with nonthermal-conductive covering material, and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, Two Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
6. Ends: Threaded or soldered.
7. Seats: PTFE.
8. Stem: Brass.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, Two Piece with Full Port and Bronze or Brass Trim, Threaded or Soldered Ends:

2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
6. Ends: Threaded or soldered.
7. Seats: PTFE.
8. Stem: Bronze.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full valve actuation movement.

F. Valve Tags: Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

H. Adjust valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, provide the same types of valves with higher SWP classes or CWP ratings.
B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Brass or bronze ball valves, two piece with brass trim, full port, and threaded or solder-joint ends.

B. Pipe NPS 2-1/2 and Larger:

1. Steel ball valves, Class 150.

END OF SECTION 23 05 23.12
SECTION 23 05 23.13 - BUTTERFLY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Iron, single-flange (lug-type) butterfly valves.
   3. Chainwheels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASME Compliance:
   1. ASME B16.1 for flanges on iron valves.
   2. ASME B16.5 for flanges on steel valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B31.1 for power piping valves.
   5. ASME B31.9 for building services valves.

B. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valve Actuator Types:
   1. Gear Actuator: For valves NPS 8 and larger.
   3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Installation of Valves" Article.

F. Valves in Insulated Piping: Provide with 2-inch extended neck stems.
2.2  IRON, SINGLE-FLANGE (LUG-TYPE) BUTTERFLY VALVES

A.  Iron, Single-Flange (Lug-Type) Butterfly Valves with Aluminum-Bronze Disc:

1.  Standard: MSS SP-67, Type I.
2.  CWP Rating: 150 psig
3.  Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
5.  Seat: EPDM
6.  Stem: One- or two-piece stainless steel.

2.3  HIGH-PERFORMANCE BUTTERFLY VALVES

A.  Single-Flange (Lug-Type), High-Performance Butterfly Valves, Class 150:

1.  Standard: MSS SP-68.
2.  CWP Rating: 285 psig at 100 deg F.
3.  Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
5.  Seat: Reinforced PTFE or metal.
6.  Stem: Stainless steel; offset from seat plane.
7.  Disc: Type 316 stainless steel.

PART 3 - EXECUTION

3.1  EXAMINATION

A.  Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B.  Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C.  Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D.  Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.
3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full valve actuation movement.

F. Valve Tags: Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

G. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. If leakage cannot be repaired, replace valve.

3.3 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger:
   2. High-Performance Butterfly Valves: Single flange, carbon-steel body, and Class 150

3.4 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger:
   2. High-Performance Butterfly Valves: Single flange, carbon-steel body, and Class 150

END OF SECTION 23 05 23.13
SECTION 23 05 23.14 - CHECK VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bronze swing check valves.

1.2 ACTION SUBMITTALS

A. Product data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges for metric standard piping.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   5. ASME B16.18 for cast copper solder joint.
   6. ASME B16.22 for wrought copper solder joint.
   8. ASME B31.1 for power piping valves.
   9. ASME B31.9 for building services piping valves.

B. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Bypass and Drain Connections: MSS SP-45.
2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 150:

1. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.

PART 3 - EXECUTION

3.1 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

C. Install valves with stem at or above center of pipe.

D. Install valves in position to allow full stem and manual operator movement.

E. Verify that joints of each valve have been properly installed and sealed to ensure that there is no leakage or damage.

F. Install check valves for proper direction of flow and as follows:

   1. Swing Check Valves: In horizontal position with hinge pin level.

G. Install valve tags. Comply with requirements for valve tags and schedules in Section 23 05 53 "Identification for HVAC Piping and Equipment."

H. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve of manufacturer's recommended maximum.

I. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
1. Pump-Discharge Check Valves:
   a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. End Connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends, except where solder-joint or press valve-end option is indicated in valve schedules.

3.3 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Bronze swing check valves with bronze disc, Class 150.

END OF SECTION 23 05 23.14
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel

B. Copper Pipe and Tube Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Hot Piping: ASTM C552, Type II cellular glass with 100-psi minimum compressive strength.

B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MATERIALS

A. Aluminum: ASTM B221.
B. Carbon Steel: ASTM A1011/A1011M.
C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
D. Stainless Steel: ASTM A240/A240M.
E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.
3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 09 91 23 "Interior Painting for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
   5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29
SECTION 23 05 48.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Elastomeric isolation pads.
   2. Elastomeric isolation mounts.
   3. Restrained elastomeric isolation mounts.
   4. Housed-spring isolators.
   5. Restrained-spring isolators.

B. Related Requirements:
   1. Section 21 05 48.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
   2. Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints.

B. Welding certificates.

C. Field quality-control reports.
1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Minimum deflection as indicated on Drawings.
4. Pad Material: Oil- and water-resistant rubber.
5. Load-bearing metal plates adhered to pads.
6. Sandwich-Core Material: Resilient and elastomeric.
   a. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Elastomeric Isolation Mounts:

1. Mounting Plates:
   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded
2. Minimum deflection as indicated on Drawings.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   a. Housing: Cast-ductile iron or welded steel.
   b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
2. Minimum deflection as indicated on Drawings.
2.4 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Minimum deflection as indicated on Drawings.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psi.
   b. Top housing with elastomeric pad.

2.5 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psi.
   b. Top plate with elastomeric pad.
   c. Internal leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Minimum deflection as indicated on Drawings.

2.6 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with non-adjustable snubbers to limit vertical movement.
a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psi.
b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Minimum deflection as indicated on Drawings.

2.7 PIPE-RISER RESILIENT SUPPORT
A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch-Thick Neoprene:
   1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
   2. Maximum Load Per Support: 500 psi on isolation material providing equal isolation in all directions.
   3. Minimum deflection as indicated on Drawings.

2.8 ELASTOMERIC HANGERS
A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
   1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.
   3. Minimum deflection as indicated on Drawings.

2.9 SPRING HANGERS
A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Minimum deflection as indicated on Drawings.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.10 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-16, Ch. 13.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

2.11 CONCRETE INSERTS

A. Provide preset concrete inserts that are prequalified in accordance with ICC-ES AC466 testing.

B. Comply with ANSI/MSS SP-58.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind force loads within specified loading limits.

3.2 INSTALLATION OF VIBRATION CONTROL DEVICES

A. Provide vibration control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules on Drawings, where Specifications indicate
they are to be installed on specific equipment and systems, and where required by applicable codes.

B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

D. Comply with requirements in Section 07 72 00 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

E. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

F. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   3. Brace a change of direction longer than 12 feet.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Post-Installed Concrete Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.
3.3 ACCOMMODATION OF DIFFERENTIAL MOTION

A. Provide flexible connections in piping systems where they cross structural joints and other points where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties" for piping flexible connections.

3.4 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

END OF SECTION 23 05 48.13
SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Duct labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples: For color, letter style, and graphic representation required for each identification material and device.
C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
   2. Letter and Background Color: As indicated for specific application under Part 3.
   3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
   4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 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 of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   6. Fasteners: Stainless steel rivets or self-tapping screws.
   7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless steel rivets or self-taping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.
2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:

   1. Duct size.
   2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.
   3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.
3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS
   A. Permanently fasten labels on each item of mechanical equipment.
   B. Sign and Label Colors:
      1. White letters on an ANSI Z535.1 safety-blue background.
   C. Locate equipment labels where accessible and visible.
   D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF PIPE LABELS
   A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
   B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
      1. Within 3 ft. of each valve and control device.
      2. At access doors, manholes, and similar access points that permit view of concealed piping.
      3. Within 3 ft. of equipment items and other points of origination and termination.
      4. Spaced at maximum intervals of 10 ft. in areas of congested piping, ductwork, and equipment.
   C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
   D. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
   E. Pipe-Label Color Schedule:

3.5 INSTALLATION OF DUCT LABELS
   A. Install self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.
      1. Provide labels in the following color codes:
         a. For air supply ducts: White letters on blue background
b. For air return ducts: White letters on blue background

c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background

END OF SECTION 23 05 53
SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
   a. Constant-volume air systems.

2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:
   a. Constant-flow hydronic systems.
   b. Variable-flow hydronic systems.

3. Testing, adjusting, and balancing of fuel oil systems for HVAC.

4. Testing, adjusting, and balancing of equipment.

5. Testing, adjusting, and balancing of existing HVAC systems and equipment.


7. Pipe leakage tests verification.

8. HVAC-control system verification.

1.2 DEFINITIONS


C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

G. UFAD: Underfloor air distribution.
1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.


D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
   2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB
   2. TAB Technician: Employee of the TAB specialist and certified by NEBB

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

F. Examine equipment performance data, including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.
I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
   b. Duct systems are complete with terminals installed.
   c. Volume, smoke, and fire dampers are open and functional.
   d. Clean filters are installed.
   e. Fans are operating, free of vibration, and rotating in correct direction.
   f. Variable-frequency controllers’ startup is complete and safeties are verified.
   g. Automatic temperature-control systems are operational.
   h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning in accordance with the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 07 13 "Duct Insulation," and Section 23 07 19 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Pumps.
3. Fans and ventilators.
4. Unit heaters.
5. Water chillers.
6. Air-handling units.
7. Coils.
8. Fan coil units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

   b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report artificial loading of filters at the time static pressures are measured.

3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
   1. Measure airflow of submain and branch ducts.
   2. Adjust submain and branch duct volume dampers for specified airflow.
   3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
   1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   2. Measure inlets and outlets airflow.
   3. Adjust each inlet and outlet for specified airflow.
   4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.
   1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
   2. Re-measure and confirm that total airflow is within design.
   3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
   4. Mark all final settings.
   5. Test system in economizer mode. Verify proper operation and adjust if necessary.
   6. Measure and record all operating data.
   7. Record final fan-performance data.
3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
   1. Check expansion tank for proper setting.
   2. Check highest vent for adequate pressure.
   3. Check flow-control valves for proper position.
   4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
   5. Verify that motor controllers are equipped with properly sized thermal protection.
   6. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
   1. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design flow.
   1. Measure total water flow.
      a. Position valves for full flow through coils.
      b. Measure flow by main flow meter, if installed.
      c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

   2. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gauge heights.
      d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.


B. Adjust flow-measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   1. Measure flow at terminals.
   2. Adjust each terminal to design flow.
   3. Re-measure each terminal after it is adjusted.
   4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:
   1. Measure differential pressure and verify that it is within manufacturer's specified range.
   2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:
   1. Measure and balance coils by either coil pressure drop or temperature method.
   2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:
   1. Re-measure and confirm that total water flow is within design.
   2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   3. Mark final settings.

G. Verify that memory stops have been set.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:
1. Verify that the pressure-differential sensor(s) is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no flow diversity:

1. Adjust pumps to deliver total design flow.
   a. Measure total water flow.
      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
   b. Measure pump TDH as follows:
      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gauge heights.
      4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
      5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
   c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:
a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system pressure-differential set point(s).

7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

8. Mark final settings and verify that all memory stops have been set.

9. Verify final system conditions as follows:
   a. Re-measure and confirm that total flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
   c. Mark final settings.

D. For systems with flow diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by Architect.
3. Adjust pumps to deliver total design flow.
   a. Measure total water flow.
      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
   b. Measure pump TDH as follows:
      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gauge heights.
      4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
      5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to
achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure, and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.

9. Prior to verifying final system conditions, determine system pressure-differential set point(s).

10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

11. Mark final settings and verify that memory stops have been set.

12. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
   c. Mark final settings.
3.10  PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.11  PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each hydronic coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Air pressure drop.
5. Voltage and amperage input of each phase at full load.
6. Calculated kilowatt at full load.
7. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Entering and leaving refrigerant pressure and temperatures.

3.12 PROCEDURES FOR EXHAUST HOODS

A. Room Pressure: Measure and record room pressure with respect to atmosphere and adjacent space with hoods in room initially not operating and then with hoods operating.

B. Makeup Air: Systems supplying source of makeup air to hoods shall be in operation during testing and balancing of exhaust hoods.
   1. Measure and record temperature of makeup air entering hood. If hood makeup air is from multiple sources having different temperatures, measure and record the airflow and temperatures of each source and calculate the weighted average temperature.
   2. Use simulated smoke to observe supply air-distribution air patterns in vicinity of hoods. Consult with hood manufacturer and report conditions that have a detrimental effect on intended capture, containment, and other attributes effecting proper operation.

C. Rooms with Multiple Hoods: Test each hood separately, one at a time, and repeat tests with all hoods intended to operate simultaneously by design.

D. Canopy Hoods: Measure and record the following:
   1. Pressure drop across hood.
   2. Airflow by duct traverse where duct distribution will allow accurate measurement, and calculate hood average face velocity.
   3. Measure velocity across hood face and calculate hood airflow.
      a. Clearly indicate the direction of flow at each point of measurement.
      b. Measure velocity across opening on not less than 12-inch centers. Record velocity at each measurement, and calculate average velocity.

E. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.

3.13 PIPE LEAKAGE TESTS

A. Witness the pipe pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.14 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:
   1. Verify HVAC control system is operating within the design limitations.
   2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.15 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).
2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
4. Check the refrigerant charge.
5. Check the condition of filters.
6. Check the condition of coils.
7. Check the operation of the drain pan and condensate-drain trap.
8. Check bearings and other lubricated parts for proper lubrication.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflow rates of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

3.16 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
3. Heating-Water Flow Rate: Plus 10 percent or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
4. Chilled-Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm, within 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.17 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.18 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.
B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:
   a. Settings for outdoor-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Heating coil, dry-bulb conditions.
   e. Face and bypass damper settings at coils.
   f. Fan drive settings, including settings and percentage of maximum pitch diameter.
   g. Variable-frequency controller settings for variable-air-volume systems.
   h. Settings for pressure controller(s).
   i. Other system operating conditions that affect performance.

16. Test conditions for pump performance forms, including the following:
   a. Variable-frequency controller settings for variable-flow hydronic systems.
   b. Settings for pressure controller(s).
   c. Other system operating conditions that affect performance.
D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Center-to-center dimensions of sheave and amount of adjustments in inches.
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and speed.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan speed.
   d. Inlet and discharge static pressure in inches wg.
   e. For each filter bank, filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
   j. Outdoor airflow in cfm.
   k. Return airflow in cfm.
l. Outdoor-air damper position.
m. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft.
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and speed.
   c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System fan and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.
J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm.
   g. Water pressure differential in feet of head or psig.
   h. Required net positive suction head in feet of head or psig.
   i. Pump speed.
   j. Impeller diameter in inches.
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
   p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

K. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.
3.19 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner.

B. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 20 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
   1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
   2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.20 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93
SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed exhaust
   4. Indoor, exposed exhaust

B. Related Sections:
   1. Section 23 07 19 "HVAC Piping Insulation."
   2. Section 23 31 13 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are applied.
B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, **Type III with factory-applied FSK jacket**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation **with factory-applied ASJ**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.


2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
2. Service Temperature Range: Minus 20 to plus 180 deg F.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials are compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Materials are compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.

2.6 FACTORY-APPLIED JACKETS
A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
   2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS
A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.
B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH
A. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

2.9 TAPES
A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
   1. Width: 3 inches
   2. Thickness: 11.5 mils
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches
2. Thickness: 6.5 mils
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.11 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum in accordance with ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.

2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

   1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.4 INSTALLATION OF GLASS-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

   c. Do not overcompress insulation during installation.

   d. Impale insulation over pins and attach speed washers.

   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

   c. Do not overcompress insulation during installation.

   d. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.6 FINISHES

A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to five location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed exhaust.
4. Indoor, exposed exhaust.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
5. Flexible connectors.
7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Glass-fiber blanket, 2 inches thick and 0.75 lb/cu. ft. nominal density.

B. Concealed, Exhaust-Air Duct and Plenum Insulation: Glass-fiber blanket, 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

C. Exposed, Supply-Air Duct and Plenum Insulation: Glass-fiber board, 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

D. Exposed, Return-Air Duct and Plenum Insulation: Glass-fiber board, 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

E. Exposed, Exhaust-Air Duct and Plenum Insulation: Glass-fiber board, 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.

D. Ducts and Plenums, Exposed:

1. Paintable Woven Polyester Mesh

END OF SECTION 23 07 13
SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes insulation for HVAC piping systems.
B. Related Requirements:
   1. Section 23 07 13 "Duct Insulation" for duct insulation.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS
A. Qualification Data: For qualified Installer.
B. Material test reports.
C. Field quality-control reports.

1.4 COORDINATION
A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.5 SCHEDULING
A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General" and "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.

1. Preformed Pipe Insulation without Jacket: Type II, Class 1, unfaced.
2. Preformed Pipe Insulation with Jacket: Type II, Class 2, with factory-applied ASJ jacket.
3. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.

G. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials, Type II, for sheet materials.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
   1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
   2. Wet Flash Point: Below 0 deg F.
   3. Service Temperature Range: 40 to 200 deg F.

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
      a. Service Temperature Range: Minus 150 to plus 250 deg F.
      b. Color: White or gray.

C. ASJ Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2.7 FIELD-APPLIED REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.9 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
   3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
   4. For below-ambient services, apply vapor-barrier mastic over staples.
   5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
   6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.
N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.3 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistant joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using prefabricated fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with prefabricated fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using prefabricated fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using prefabricated fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe
insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
   2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.
3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless steel jackets.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 3/4 inch thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
   1. NPS 12 and Smaller: Insulation shall be the following:

C. Refrigerant Suction and Hot-Gas Piping:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.

D. Refrigerant Suction and Hot-Gas Flexible Tubing:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 2 inches thick.

E. Refrigerant Liquid Piping:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. None.

D. Piping, Exposed:
   1. Paintable Woven Cloth

END OF SECTION 23 07 19
PART 1 – GENERAL

1.01 The Functional Performance Testing of the mechanical systems is essential to the operation and performance of the equipment and the completion of the project. Complete all inspections and tests prior to substantial completion of the Work.

PART 2 – PRODUCTS

2.01 TEST INSTRUMENTATION:
   A. The following are suggested testing instruments that could be used but similar types of instruments are acceptable. If the Designer determines that additional instruments are required, provide at no additional charge.
   B. Recommended Instruments for testing purposes
      1. Shortridge Instruments: Air Data – Multimeter ADM – 860, 870 or 880
      2. EXTECH Instruments: Digital Psychrometer + InfraRed Thermometer RH401
      3. ThermoWorks: MTC Mini Handheld Thermocouple

PART 3 – EXECUTION

3.01 The Functional Performance Testing Procedures, approved by the Designer, will be used to document the inspection and testing of the equipment and systems. Provide all necessary manpower and have the appropriate subcontractor and/or manufacturer’s representative present during the testing and demonstrate, to the Designers satisfaction, the full operation of all mechanical and control equipment and systems. Coordinate the schedule of the testing so that the Designer and Owner can be present.

   A. Prior to starting the final testing of the systems, ensure that all equipment and systems were initially started-up and initialized as prescribed by the manufacturer’s instruction or by the manufacturer’s representative and that the Contractor has performed a complete operational test of all mechanical equipment and systems to ensure proper operation.

   B. Review the Designer’s inspection reports and correct all deficiencies.

   C. Review the test and balance report and correct all deficiencies.

   D. Demonstrate the accuracy of 20% of the air and 20% of the water readings; and, if more than 10% are incorrect by +/- 10% continue to check 50% of the reports readings. If more than 10% of the additional readings are incorrect, have the test and balance subcontractor recheck all readings.

   E. Test and balance readings that are verified will be recorded on the Terminal Box Point Calibration Check Sheet (see Division 23 group 08 specifications). The Designer may utilize the test and balance instruments furnished by the test and balance contractor or provide their own instruments. All instruments utilized must have been calibrated within the past 12 months.

   F. Demonstrate that all specified control equipment, software and system graphics are loaded into the operating system.
G. Check all control system control panels for cleanliness, neatness and that they are installed as specified.

H. Check the accuracy of all points and recorded readings on the Sensor Point Calibration Check Sheet (see Division 23 group 08 specifications).

I. In the event that the equipment, systems and/or sequences have been modified prior to the inspection and testing, document the modifications and correct the Performance Testing Procedures Form so that the system verification can continue.

J. Demonstrate the proper operation of the mechanical equipment and systems using the Performance Testing Identification Form and Performance Testing Procedures Forms approved by the Designer (see Division 01 group 91 specifications). During the testing, record on the forms the system response and point values to the operation. Record deficiencies, corrected and retested.

K. Upon completion of the performance testing procedures, the installer, Contractor and Designers representatives, who observed the testing, will sign the Functional Performance Test Certification form (see Division 01 group 91 specifications) and attach deficiency list. Systems to be addressed include but are not limited to:

1. Mechanical systems
2. Control system
3. Domestic hot water system

L. Provide testing instruments, at no charge or the Designer may elect to provide their own instruments.

END OF SECTION
List all sensors associated with this system or unit and verify the calibration, set point and location.

<table>
<thead>
<tr>
<th>Sensor Description</th>
<th>Location Satisfactory (Y/N)</th>
<th>BAS Reading</th>
<th>Field Measurement Value</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
SECTION 23 09 23 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. DDC system for monitoring and controlling of HVAC systems.
2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

B. Related Requirements:

1. Communications Cabling:
   a. Section 26 05 23 "Control-Voltage Electrical Power Cables" for balanced twisted pair communications cable.
   b. Section 27 15 13 "Communications Copper Horizontal Cabling" for balanced twisted pair communications cable.

2. Raceways:
   a. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for raceways for low-voltage control cable.
   b. Section 27 05 28 "Pathways for Communications Systems" for raceways for balanced twisted pair cabling and optical fiber cable.

3. Section 26 05 53 "Identification for Electrical Systems" for identification requirements for electrical components.
4. Section 27 05 53 "Identification for Communications Systems" for identification requirements for communications components.

1.3 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:
1. **BACnet**: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.

2. **BACnet Interoperability Building Blocks (BIBBs)**: BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.

3. **BACnet/IP**: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.

4. **BACnet Testing Laboratories (BTL)**: Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.

5. **PICS (Protocol Implementation Conformance Statement)**: Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. **Binary**: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. **Controller**: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.

F. **Control System Integrator**: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. **COV**: Changes of value.

H. **DDC System Provider**: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. **Distributed Control**: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

J. **DOCSIS**: Data-Over Cable Service Interface Specifications.

K. **E/P**: Voltage to pneumatic.

L. **Gateway**: Bidirectional protocol translator that connects control systems that use different communication protocols.

M. **HLC**: Heavy load conditions.

N. **I/O**: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
O. I/P: Current to pneumatic.

P. LAN: Local area network.

Q. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

R. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.

S. Modbus TCP/IP: An open protocol for exchange of process data.

T. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

U. MTBF: Mean time between failures.

V. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

W. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

X. Peer to Peer: Networking architecture that treats all network stations as equal partners.

Y. POT: Portable operator's terminal.

Z. PUE: Performance usage effectiveness.

AA. RAM: Random access memory.

BB. RF: Radio frequency.

CC. Router: Device connecting two or more networks at network layer.

DD. Server: Computer used to maintain system configuration, historical and programming database.

EE. TCP/IP: Transport control protocol/Internet protocol.

FF. UPS: Uninterruptible power supply.

GG. USB: Universal Serial Bus.

HH. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

II. VAV: Variable air volume.

JJ. WLED: White light emitting diode.
1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Multiple Submissions:
   1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.
   2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.
   3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.

B. Product Data: For each type of product include the following:
   1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
   4. Installation, operation and maintenance instructions including factors effecting performance.
   5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
      a. Gateways.
      b. Routers.
      c. DDC controllers.
      d. Enclosures.
      e. Electrical power devices.
      f. UPS units.
      g. Accessories.
      h. Instruments.
      i. Control dampers and actuators.
      j. Control valves and actuators.
   6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
   7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

C. Software Submittal:
1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

D. Shop Drawings:

1. General Requirements:
   a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
   b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail means of vibration isolation and show attachments to rotating equipment.
5. Plan Drawings indicating the following:
   a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
   b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
   c. Each desktop workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
   d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
   e. Network communication cable and raceway routing.
f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

6. Schematic drawings for each controlled HVAC system indicating the following:
   a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
   b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
   c. A graphic showing location of control I/O in proper relationship to HVAC system.
   d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
   e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
   f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
   g. Narrative sequence of operation.
   h. Graphic sequence of operation, showing all inputs and output logical blocks.

7. Control panel drawings indicating the following:
   a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
   b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
   c. Front, rear, and side elevations and nameplate legend.
   d. Unique drawing for each panel.

8. DDC system network riser diagram indicating the following:
   a. Each device connected to network with unique identification for each.
   b. Interconnection of each different network in DDC system.
   c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.
   d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

9. DDC system electrical power riser diagram indicating the following:
   a. Each point of connection to field power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
   b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
   c. Each product requiring power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
   d. Power wiring type and size, race type, and size for each.
10. Monitoring and control signal diagrams indicating the following:
   a. Control signal cable and wiring between controllers and I/O.
   b. Point-to-point schematic wiring diagrams for each product.
   c. Control signal tubing to sensors, switches and transmitters.
   d. Process signal tubing to sensors, switches and transmitters.

11. Color graphics indicating the following:
   a. Itemized list of color graphic displays to be provided.
   b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
   c. Intended operator access between related hierarchical display screens.

E. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. System and product operation under each potential failure condition including, but not limited to, the following:
   a. Loss of power.
   b. Loss of network communication signal.
   c. Loss of controller signals to inputs and outpoints.
   d. Operator workstation failure.
   e. Server failure.
   f. Gateway failure.
   g. Network failure
   h. Controller failure.
   i. Instrument failure.
   j. Control damper and valve actuator failure.

4. Complete bibliography of documentation and media to be delivered to Owner.
5. Description of testing plans and procedures.
6. Description of Owner training.

F. Delegated-Design Submittal: For DDC system products and installation indicated as being delegated.

1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
2. Schedule and design calculations for control dampers and actuators.
   a. Flow at Project design and minimum flow conditions.
   b. Face velocity at Project design and minimum airflow conditions.
   c. Pressure drop across damper at Project design and minimum airflow conditions.
d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
e. Maximum close-off pressure.
f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.
i. Actuator signal to control damper (on, close or modulate).
j. Actuator position on loss of power.
k. Actuator position on loss of control signal.

3. Schedule and design calculations for control valves and actuators.
   a. Flow at Project design and minimum flow conditions.
   b. Pressure-differential drop across valve at Project design flow condition.
   c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
   d. Design and minimum control valve coefficient with corresponding valve position.
   e. Maximum close-off pressure.
   f. Leakage flow at maximum system pressure differential.
   g. Torque required at worst case condition for sizing actuator.
   h. Actuator selection indicating torque provided.
   i. Actuator signal to control damper (on, close or modulate).
   j. Actuator position on loss of power.
   k. Actuator position on loss of control signal.

4. Schedule and design calculations for selecting flow instruments.
   a. Instrument flow range.
   b. Project design and minimum flow conditions with corresponding accuracy, control signal to transmitter and output signal for remote control.
   c. Extreme points of extended flow range with corresponding accuracy, control signal to transmitter and output signal for remote control.
   d. Pressure-differential loss across instrument at Project design flow conditions.
   e. Where flow sensors are mated with pressure transmitters, provide information for each instrument separately and as an operating pair.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. Systems Provider Qualification Data:
   a. Resume of project manager assigned to Project.
   b. Resumes of application engineering staff assigned to Project.
   c. Resumes of installation and programming technicians assigned to Project.
   d. Resumes of service technicians assigned to Project.
   e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
h. Owner contact information for past project including name, phone number, and e-mail address.
i. Contractor contact information for past project including name, phone number, and e-mail address.
j. Architect and Engineer contact information for past project including name, phone number, and e-mail address.

2. Manufacturer's qualification data.
3. Testing agency's qualifications data.

B. Welding certificates.

C. Product Certificates:
   1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

D. Product Test Reports: For each product that requires testing to be performed by manufacturer.

E. Preconstruction Test Reports: For each separate test performed.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For manufacturer's warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
   1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
      a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
      b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
      c. As-built versions of submittal Product Data.
      d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
      e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

g. Engineering, installation, and maintenance manuals that explain how to:

1) Design and install new points, panels, and other hardware.
2) Perform preventive maintenance and calibration.
3) Debug hardware problems.
4) Repair or replace hardware.

h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.

i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.

j. List of recommended spare parts with part numbers and suppliers.

k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.

m. Licenses, guarantees, and warranty documents.

n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

o. Owner training materials.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Include product manufacturers' recommended parts lists for proper product operation over four-year period following warranty period. Parts list shall be indicated for each year.

1.9 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

1. Nationally recognized manufacturer of DDC systems and products.

2. DDC systems with similar requirements to those indicated for a continuous period of five years within time of bid.

3. DDC systems and products that have been successfully tested and in use on at least three past projects.

4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.

5. Having full-time in-house employees for the following:

a. Product research and development.
b. Product and application engineering.
c. Product manufacturing, testing and quality control.
d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
e. Owner operator training.

B. DDC System Provider Qualifications:

1. Authorized representative of, and trained by, DDC system manufacturer.
2. Demonstrated past experience with installation of DDC system products being installed for period within three consecutive years before time of bid.
3. Demonstrated past experience on five projects of similar complexity, scope and value.
4. Each person assigned to Project shall have demonstrated past experience.
5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
6. Service and maintenance staff assigned to support Project during warranty period.
7. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
8. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

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. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
   a. Install updates only after receiving Owner's written authorization.
3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: Two year(s) from date of Substantial Completion.
   a. For Gateway: Two-year parts and labor warranty for each.

PART 2 - PRODUCTS

2.1 DDC SYSTEM MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include are not limited to the following:
      1. Johnson Controls, Inc.

2.2 DDC SYSTEM DESCRIPTION
   A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.
      1. DDC system shall consist of a peer-to-peer network of distributed DDC controllers, operator interfaces, and software.
   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.

2.3 WEB ACCESS
   A. DDC system shall be Web based or Web compatible.
      1. Web-Based Access to DDC System:
         a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.
         b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
         c. Web access shall be password protected.
      2. Web-Compatible Access to DDC System:
2.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.

1. System Performance Objectives:
   a. DDC system shall manage HVAC systems.
   b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
   c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
   d. DDC system shall operate while unattended by an operator and through operator interaction.
   e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. DDC System Speed:

1. Response Time of Connected I/O:
   a. AI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
   b. BI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
   c. AO points connected to DDC system shall begin to respond to controller output commands within two second(s). Global commands shall also comply with this requirement.
   d. BO point values connected to DDC system shall respond to controller output commands within two second(s). Global commands shall also comply with this requirement.
2. Display of Connected I/O:
   a. Analog point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.
   b. Binary point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.
   c. Alarms of analog and digital points connected to DDC system shall be displayed within 45 seconds of activation or change of state.
   d. Graphic display refresh shall update within eight seconds.
   e. Point change of values and alarms displayed from workstation to workstation when multiple operators are viewing from multiple workstations shall not exceed graphic refresh rate indicated.

D. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

E. DDC System Data Storage:
   1. Include capability to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
   2. Local Storage:
      a. Provide workstation with data storage indicated. Server(s) shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.
   3. Cloud Storage:
      a. Provide application-based and web browser interfaces to configure, upload, download, and manage data, and service plan with storage adequate to store all data for term indicated. Cloud storage shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.

F. DDC Data Access:
   1. When logged into the system, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
   2. System(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.

G. Future Expandability:
   1. DDC system size shall be expandable to an ultimate capacity of at least three times total I/O points indicated.
2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.

3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

H. Input Point Displayed Accuracy: Input point displayed values shall meet following end-to-end overall system accuracy, including errors associated with meter, sensor, transmitter, lead wire or cable, and analog to digital conversion.

1. Energy:
   a. Thermal: Within 5 percent of reading.
   b. Electric Power: Within 1 percent of reading.
   c. Requirements indicated on Drawings for meters not supplied by utility.

2. Flow:
   a. Air: Within 5 percent of design flow rate.
   b. Air (Terminal Units): Within 10 percent of design flow rate.
   c. Water: Within 5 percent of design flow rate.
   d. Steam: Within 5 percent of design flow rate.

3. Moisture (Relative Humidity):
   a. Air: Within 5 percent RH.
   b. Space: Within 5 percent RH.
   c. Outdoor: Within 5 percent RH.

4. Level: Within 5 percent of reading.

5. Pressure:
   a. Air, Ducts and Equipment: 1 percent of instrument range.
   b. Space: Within 1 percent of instrument range.
   c. Water: Within 1 percent of instrument range.


7. Temperature, Dew Point:
   a. Air: Within 1 deg F.
   b. Space: Within 1 deg F.
   c. Outdoor: Within 3 deg F.

8. Temperature, Dry Bulb:
   a. Air: Within 1 deg F.
   b. Space: Within 1 deg F.
   c. Outdoor: Within 2 deg F.
   d. Chilled Water: Within 1 deg F.
   e. Condenser Water: Within 1 deg F.
f. Heating Hot Water: Within 1 deg F.
g. Temperature Difference: Within 0.25 deg F.
h. Other Temperatures Not Indicated: Within 1 deg F.

9. Temperature, Wet Bulb:
   a. Air: Within 1 deg F.
   b. Space: Within 1 deg F.
   c. Outdoor: Within 2 deg F.

10. Vibration: Within 5 percent of reading.

1. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:

   1. Current:
      a. Milliamperes: Nearest 1/100th of a milliampere.
      b. Amperes: Nearest 1/10th of an ampere up to 100 A; nearest ampere for 100 A and more.

   2. Moisture (Relative Humidity):
      a. Relative Humidity (Percentage): Nearest 1 percent.

   3. Level: Nearest 1/100th of an inch through 10 inches; nearest 1/10 of an inch between 10 and 100 inches; nearest inch above 100 inches.

   4. Speed:
      a. Rotation (rpm): Nearest 1 rpm.
      b. Velocity: Nearest 1/10th fpm through 100 fpm; nearest fpm between 100 and 1000 fpm; nearest 10 fpm above 1000 fpm.

   5. Position, Dampers and Valves (Percentage Open): Nearest 1 percent.

   6. Pressure:
      a. Air, Ducts and Equipment: Nearest 1/100th in. w.c..
      b. Space: Nearest 1/100th in. w.c..
      c. Steam: Nearest 1/10th psig through 100 psig; nearest psig above 100 psig.
      d. Water: Nearest 1/10 psig through 100 psig; nearest psig above 100 psig.

   7. Temperature:
      a. Air, Ducts and Equipment: Nearest 1/10th of a degree.
      b. Outdoor: Nearest degree.
      c. Space: Nearest 1/10th of a degree.
      d. Chilled Water: Nearest 1/10th of a degree.
      e. Condenser Water: Nearest 1/10th of a degree.
      f. Heating Hot Water: Nearest degree.
      g. Heat Recovery Runaround: Nearest 1/10th of a degree.
h. Steam: Nearest degree.

8. Vibration: Nearest 1/10th in/s.
9. Voltage: Nearest 1/10 volt up to 100 V; nearest volt above 100 V.

J. Control Stability: Control variables indicated within the following limits:

1. Flow:
   a. Air, Ducts and Equipment, except Terminal Units: Within 5 percent of design flow rate.
   b. Air, Terminal Units: Within 10 percent of design flow rate.
   c. Water: Within 5 percent of design flow rate.
   d. Steam: Within 5 percent of design flow rate.

2. Moisture (Relative Humidity):
   a. Air: Within 5 percent RH.
   b. Space: Within 5 percent RH.
   c. Outdoor: Within 5 percent RH.

3. Level: Within 5 percent of reading.

4. Pressure:
   a. Air, Ducts and Equipment: 1 percent of instrument range.
   b. Space: Within 1 percent of instrument range.
   c. Water: Within 1 percent of instrument range.
   d. Steam: Within 1 percent of instrument range.

5. Temperature, Dew Point:
   a. Air: Within 1 deg F.
   b. Space: Within 1 deg F.

6. Temperature, Dry Bulb:
   a. Air: Within 2 deg F.
   b. Space: Within 2 deg F.
   c. Chilled Water: Within 1 deg F.
   d. Condenser Water: Within 1 deg F.
   e. Heating Hot Water: Within 2 deg F.

7. Temperature, Wet Bulb:
   a. Air: Within 1 deg F.
   b. Space: Within 1 deg F.

K. Environmental Conditions for Controllers, Gateways, and Routers:
1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
   
a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
   
a. Outdoors, Protected: Type 2.
   b. Indoors, Heated with Filtered Ventilation: Type 1.
   c. Indoors, Heated with Non-Filtered Ventilation: Type 2.
   d. Indoors, Heated and Air Conditioned: Type 1.
   e. Mechanical Equipment Rooms:
      1) Chiller and Boiler Rooms: Type 4X.
      2) Air-Moving Equipment Rooms: Type 1.
   
f. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
   g. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.
   h. Hazardous Locations: Explosion-proof rating for condition.

L. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
   
a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
   
a. Outdoors, Protected: Type 2.
   b. Outdoors, Unprotected: Type 4X.
   c. Indoors, Heated with Filtered Ventilation: Type 1.
   d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
e. Indoors, Heated and Air-conditioned: Type 1.
f. Mechanical Equipment Rooms:
   1) Chiller and Boiler Rooms: Type 4X.
   2) Air-Moving Equipment Rooms: Type 1.

g. Localized Areas Exposed to Washdown: Type 4X.
h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.

M. Backup Power Source:
   1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

N. UPS:
   1. DDC system products powered by UPS units shall include the following:
      a. Desktop workstations.
      b. Printers.
      c. Servers.
      d. Gateways.
      e. DDC controllers.

O. Continuity of Operation after Electric Power Interruption:
   1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than two levels of LANs.
   1. Level one LAN shall connect network controllers and operator workstations.
   2. Level two LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.

B. Minimum Data Transfer and Communication Speed:
   1. LAN Connecting Operator Workstations and Network Controllers: 100 Mbps.
2. LAN Connecting Programmable Application Controllers: 1000 kbps.
3. LAN Connecting Application-Specific Controllers: 76,800 bps.

C. DDC system shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.

D. System architecture shall be modular and have inherent ability to expand to not less than two times system size indicated with no impact to performance indicated.

E. System architecture shall perform modifications without having to remove and replace existing network equipment.

F. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

G. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

H. Special Network Architecture Requirements:

1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Basically, create a DDC system LAN that aligns with air-handling system being controlled.

2.6 DDC SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:

1. Desktop and portable workstation with hardwired connection through LAN port.
2. Portable operator terminal with hardwired connection through LAN port.
3. Portable operator workstation with wireless connection through LAN router.
4. Mobile device and application with secured wireless connection through LAN router or cellular data service.
5. Remote connection through web access.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. Network Ports: For hardwired connection of desktop or portable workstation. Network port shall be easily accessible, properly protected, clearly labeled, and installed at the following locations:

1. Each mechanical equipment room.
2. Each boiler room.
3. Each chiller room or outdoor chiller yard.
4. Each cooling tower location.
5. Each different roof level with roof-mounted air-handling units or rooftop units.
7. Fire-alarm system command center.

D. Desktop Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.

E. Portable Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Connect to DDC system Level two or Level three LAN through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
4. Connect to system through a wireless router connected to Level one LAN.
5. Connect to system through a cellular data service.
6. Portable workstation shall be able to communicate with any device connected to any system LAN regardless of point of physical connection to system.
7. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
8. Have dynamic graphic displays that are identical to desktop workstations.

F. POT:

1. Connect DDC controller through a communications port local to controller.
2. Able to communicate with any DDC system controller that is directly connected.

G. Mobile Device:

1. Connect to system through a wireless router connected to LAN.
2. Able to communicate with any DDC controller connected to DDC system using a dedicated application and secure web access.

H. Telephone Communications:

1. Through use of a standard modem, operator shall be able to communicate with any device connected to any system LAN.
2. Have auto-dial and auto-answer communications to allow desktop and portable workstations and DDC controllers to communicate with remote workstations and remote DDC controllers via telephone lines.

   a. Desktop and Portable Workstations:

      1) Operators shall be able to perform all control functions, report functions, and database generation and modification functions as if directly connected to system LAN.
2)  Have routines to automatically answer calls, and either file or display information sent remotely.
3)  Communications taking place over telephone lines shall be completely transparent to operator.
4)  Dial-up program shall maintain a user-definable cross-reference and associated telephone numbers so it is not required to remember or manually dial telephone numbers.

b.  DDC Controllers:

1)  Not have modems unless specifically indicated for a unique controller.
2)  Controllers with modems shall automatically place calls to report critical alarms, or to upload trend and historical information for archiving.
3)  Analyze and prioritize alarms to minimize initiation of calls.
4)  Buffer noncritical alarms in memory and report them as a group of alarms, or until an operator manually requests an upload.
5)  Make provisions for handling busy signals, no-answers, and incomplete data transfers.
6)  Call default devices when communications cannot be established with primary devices.

I.  Critical Alarm Reporting:

1.  Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
2.  DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
3.  DDC system shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.

J.  Simultaneous Operator Use: Capable of accommodating up to five simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.7  NETWORKS

A.  Acceptable networks for connecting workstations, mobile devices, and network controllers include the following:
1.  IP.
2.  IEEE 8802-3, Ethernet.

B.  Acceptable networks for connecting programmable application controllers include the following:
1.  IP.
2.  IEEE 8802-3, Ethernet.

C.  Acceptable networks for connecting application-specific controllers include the following:
1.  EIA-485A.
2.  IP.
3.  IEEE 8802-3, Ethernet.
2.8 NETWORK COMMUNICATION PROTOCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to Owner and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:
   1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
   2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
   3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
   4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.

C. Industry Standard Protocols:
   1. DDC system shall use any one or a combination of the following industry standard protocols for network communication while complying with other DDC system requirements indicated:
      a. ASHRAE 135.
      b. Operator workstations and network controllers shall communicate through ASHRAE 135 protocol.
      c. Portions of DDC system networks using ASHRAE 135 communication protocol shall be an open implementation of network devices complying with ASHRAE 135. Network devices shall be tested and listed by BACnet Testing Laboratories.
      d. Gateways shall be used to connect networks and network devices using different protocols.

2.9 SYSTEM SOFTWARE

A. System Software Minimum Requirements:
   1. Real-time multitasking and multiuser 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
   2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
   3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.

5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.

6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.

2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.

3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.

4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.

5. Operator sign-on and sign-off activity shall be recorded and sent to printer.

6. Security Access:

   a. Operator access to DDC system shall be under password control.

   b. An alphanumeric password shall be field assignable to each operator.

   c. Operators shall be able to access DDC system by entry of proper password.

   d. Operator password shall be same regardless of which computer or other interface means is used.

   e. Additions or changes made to passwords shall be updated automatically.

   f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.

   g. Software shall have at least five access levels.

   h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.

   i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

7. Data Segregation:

   a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.

   b. Include at least 32 segregation groups.

   c. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.

   d. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
e. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
f. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.

8. Operators shall be able to perform commands including, but not limited to, the following:

a. Start or stop selected equipment.
b. Adjust set points.
c. Add, modify, and delete time programming.
d. Enable and disable process execution.
e. Lock and unlock alarm reporting for each point.
f. Enable and disable totalization for each point.
g. Enable and disable trending for each point.
h. Override control loop set points.
i. Enter temporary override schedules.
j. Define holiday schedules.
k. Change time and date.
l. Enter and modify analog alarm limits.
m. Enter and modify analog warning limits.
n. View limits.
o. Enable and disable demand limiting.
p. Enable and disable duty cycle.
q. Display logic programming for each control sequence.

9. Reporting:

a. Generated automatically and manually.
b. Sent to displays, printers and disk files.
c. Types of Reporting:

1) General listing of points.
2) List points currently in alarm.
3) List of off-line points.
4) List points currently in override status.
5) List of disabled points.
6) List points currently locked out.
7) List of items defined in a "Follow-Up" file.
8) List weekly schedules.
9) List holiday programming.
10) List of limits and deadbands.

10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable
(for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.

2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.

3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.

4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.

5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.

6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.

7. Graphics are to be online programmable and under password control.

8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.

9. Graphics shall also contain software points.

10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.

11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.

12. Display operator accessed data on the monitor.

13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.

14. Include operator with means to directly access graphics without going through penetration path.

15. Dynamic data shall be assignable to graphics.

16. Display points (physical and software) with dynamic data provided by DDC system with appropriate text descriptors, status or value, and engineering unit.

17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.

18. Points shall be dynamic with operator adjustable update rates on a per point basis from one second to over a minute.

19. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.

   a. For an analog command point such as set point, current conditions and limits shall be displayed and operator can position new set point using pointing device.

   b. For a digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.

   c. Keyboard equivalent shall be available for those operators with that preference.

20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature
shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.

21. Help Features:
   a. On-line context-sensitive help utility to facilitate operator training and understanding.
   b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.

1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed word-processing program, which shall run concurrently with operating system software.

   c. Available for Every Menu Item:

1) Index items for each system menu item.

22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.

   a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves, pumps, and electrical symbols.
   b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:

1) Define background screens.
2) Define connecting lines and curves.
3) Locate, orient and size descriptive text.
4) Define and display colors for all elements.
5) Establish correlation between symbols or text and associated system points or other displays.

D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.

2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:

   a. Room layouts with room identification and name.
   b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
   c. Location and identification of each hardware point being controlled or monitored by DDC system.

3. Control schematic for each of following, including a graphic system schematic representation with point identification, set point and dynamic value indication, sequence of operation and control logic diagram.
4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.
5. DDC system network riser diagram that shows schematic layout for entire system including all networks and all controllers, gateways operator workstations and other network devices.

E. Customizing Software:

1. Software to modify and tailor DDC system to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
2. Online modification of DDC system configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
3. As a minimum, include the following modification capability:
   a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
   b. Peripheral assignment capability shall include assignment of segregation groups and operators to consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
   c. System configuration and diagnostic capability shall include communications and peripheral port assignments, DDC controller assignments to network, DDC controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.
   d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.
   e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.
   f. Point related change capability shall include the following:
      1) System and point enable and disable.
      2) Run-time enable and disable.
      3) Assignment of points to segregation groups, calibration tables, lockout, and run time and to a fixed I/O value.
      4) Assignment of alarm and warning limits.
   g. Application program change capability shall include the following:
      1) Enable and disable of software programs.
      2) Programming changes.
      3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.
4. Software shall allow operator to add points, or groups of points, to DDC system and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using operator workstation, downloaded to other network devices and entered into their databases. After verification of point
additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.
5. Include high-level language programming software capability for implementation of custom DDC programs. Software shall include a compiler, linker, and up- and down-load capability.
6. Include a library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences. Also include, as a minimum, the following:
   a. Proportional control (P).
   b. Proportional plus integral (PI).
   c. Proportional plus integral plus derivative (PID).
   d. Adaptive and intelligent self-learning control.

   1) Algorithm shall monitor loop response to output corrections and adjust loop response characteristics according to time constant changes imposed.
   2) Algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of system dynamics so that on system shut down and restart, learning process starts from where it left off.

7. Fully implemented intrinsic control operators including sequence, reversing, ratio, time delay, time of day, highest select AO, lowest select AO, analog controlled digital output, analog control AO, and digitally controlled AO.
8. Logic operators such as "And," "Or," "Not," and others that are part of a standard set available with a high-level language.
9. Arithmetic operators such as "Add," "Subtract," "Multiply," "Divide," and others that are part of a standard set available with a high-level language.
10. Relational operators such as "Equal To," "Not Equal To," "Less Than," "Greater Than," and others that are part of a standard set available with a high-level language.

F. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways and other network devices.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
4. Alarms display shall include the following:

   a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
   b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
   c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
6. Send e-mail alarm messages to designated operators.
7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
8. Alarms shall be categorized and processed by class.
   a. Class 1:
      1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
      2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
      3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.
   b. Class 2:
      1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
      2) Acknowledgement may be through a multiple alarm acknowledgment.
   c. Class 3:
      1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
      2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
      3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
      4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.
   d. Class 4:
      1) Routine maintenance or other types of warning alarms.
      2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.
9. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
10. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

G. Reports and Logs:
1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on server for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on workstation and server hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

H. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:
   a. Alarm history.
   b. System messages.
   c. System events.
   d. Trends.

I. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.

J. Standard Trends:

1. Trend all I/O point present values, set points, and other parameters indicated for trending.
2. Trends shall be associated into groups, and a trend report shall be set up for each group.
3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75 of DDC controller buffer limit, or by operator request, or by archiving time schedule.
4. Preset trend intervals for each I/O point after review with Owner.
5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
6. When drive storage memory is full, most recent data shall overwrite oldest data.
7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

K. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.

1. Each trend shall include interval, start time, and stop time.
2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on server hard drives.
3. Data shall be retrievable for use in spreadsheets and standard database programs.

L. Programming Software:
   1. Include programming software to execute sequences of operation indicated.
   2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
   3. Programming software shall be one of the following:
      a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for DDC control systems.
         1) Function blocks shall be assembled with interconnection lines that represent control sequence in a flowchart.
         2) Programming tools shall be viewable in real time to show present values and logical results of each function block.
      b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.
      c. Line by Line and Text Based: Programming shall declare variable types such as local, global, real, integer, and so on, at the beginning of the program. Use descriptive comments frequently to describe programming code.
   4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

M. Database Management Software:
   1. Where a separate SQL database is used for information storage, DDC system shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.
   2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of DDC system applications.
   3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:
      a. Backup.
      b. Purge.
      c. Restore.
   4. Database management software shall support the following:
      a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
      b. Maintenance: Include method of purging records from trend, alarm, event and audit databases by supporting separate screens for creating a backup before
purging, selecting database, and allowing for retention of a selected number of day's data.

c. Backup: Include means to create a database backup file and select a storage location.
d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.

5. Database management software shall include information of current database activity, including the following:

a. Ready.
b. Purging record from a database.
c. Action failed.
d. Refreshing statistics.
e. Restoring database.
f. Shrinking a database.
g. Backing up a database.
h. Resetting Internet information services.
i. Starting network device manager.
j. Shutting down the network device manager.
k. Action successful.

6. Database management software monitoring functions shall continuously read database information once operator has logged on.

7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.

8. Monitoring settings window shall have the following sections:

a. Allow operator to set and review scan intervals and start times.
b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.
c. Warning: Allow operator to define warning limit parameters, set reminder frequency and link e-mail message.
d. Alarm: Allow operator to define alarm limit parameters, set reminder frequency and link e-mail message.
e. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit databases as well as operator proper security access to restore a database.

9. Monitoring settings taskbar shall include the following informational icons:

a. Normal: Indicates by color and size, or other easily identifiable means that all databases are within their limits.
b. Warning: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their warning limit.
c. Alarm: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their alarm limit.
2.10 OFFICE APPLICATION SOFTWARE

A. Include current version of office application software at time of Substantial Completion.

B. Office application software package shall include multiple separate applications and use a common platform for all applications, similar to Microsoft's "Office Professional."

1. Database.
2. E-mail.
3. Presentation.
4. Publisher.
5. Spreadsheet.

2.11 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, chillers, and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment, only when specifically requested and approved by Owner.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.
2.12 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:
   1. Controller hardware shall be suitable for the anticipated ambient conditions.
   2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
   3. Controllers located outdoors shall be rated for operation at 40 to 150 deg F.

F. Power and Noise Immunity:
   1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
   2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:
   1. Network Controllers:
      a. 10 percent of each AI, AO, BI, and BO point connected to controller.
      b. Minimum Spare I/O Points per Controller:
         1) AIs: Two.
         2) AOs: Two.
         3) BIs: Three.
         4) BOs: Three.
   2. Programmable Application Controllers:
      a. 10 percent of each AI, AO, BI, and BO point connected to controller.
      b. Minimum Spare I/O Points per Controller:
         1) AIs: Two.
         2) AOs: Two.
         3) BIs: Three.
         4) BOs: Three.
3. Application-Specific Controllers:
   a. 10 percent of each AI, AO, BI, and BO point connected to controller.
   b. Minimum Spare I/O Points per Controller:
      1) AIs: One.
      2) AOs: One.
      3) BIs: One.
      4) BOs: One.

H. Maintenance and Support: Include the following features to facilitate maintenance and support:
   1. Mount microprocessor components on circuit cards for ease of removal and replacement.
   2. Means to quickly and easily disconnect controller from network.
   3. Means to quickly and easily access connect to field test equipment.
   4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

I. Input and Output Point Interface:
   1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
   2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
   3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
   4. AIs:
      a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
      b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
      c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
      d. Signal conditioning including transient rejection shall be provided for each AI.
      e. Capable of being individually calibrated for zero and span.
      f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.
   5. AOs:
      a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
      b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
      c. Capable of being individually calibrated for zero and span.
      d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.
6. **BIs:**
   
a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.

7. **BOs:**
   
a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.

   1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
   2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.

b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
c. BOs shall be selectable for either normally open or normally closed operation.
d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.
e. Limit use of three-point floating devices to VAV terminal unit control applications. Control algorithms shall operate actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.13 **NETWORK CONTROLLERS**

A. **General Network Controller Requirements:**

   1. Include adequate number of controllers to achieve performance indicated.
   2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
   3. Controller shall have enough memory to support its operating system, database, and programming requirements.
   4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.

6. Controllers shall have a real-time clock.

7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.

8. Controllers shall be fully programmable.

B. Communication:

1. Network controllers shall communicate with other devices on DDC system Level one network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:
   a. Equip controller with local keypad and digital display for interrogating and editing data.
   b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.14 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.

7. Controllers shall be fully programmable.

B. Communication:

1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:
   a. Equip controller with local keypad and digital display for interrogating and editing data.
   b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.15 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.16 CONTROLLER SOFTWARE

A. General Controller Software Requirements:
   1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
   2. I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
   3. Control functions shall be executed within controllers using DDC algorithms.
   4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:
   1. Operator access shall be secured using individual security passwords and user names.
   2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
   3. Operator log-on and log-off attempts shall be recorded.
   4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:
   1. Weekly Schedule:
      a. Include separate schedules for each day of week.
      b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
      c. Each schedule may consist of up to 10 events.
      d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.
   2. Exception Schedules:
      a. Include ability for operator to designate any day of the year as an exception schedule.
      b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.
   3. Holiday Schedules:
a. Include capability for operator to define up to 99 special or holiday schedules.
b. Schedules may be placed on scheduling calendar and will be repeated each year.
c. Operator shall be able to define length of each holiday period.

D. System Coordination:
1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:
1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:
1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:
1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:
1. System shall have ability to dial out in the event of an alarm.

I. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

J. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

K. Control Loops:
1. Support any of the following control loops, as applicable to control required:
   a. Two-position (on/off, open/close, slow/fast) control.
   b. Proportional control.
   c. Proportional plus integral (PI) control.
   d. Proportional plus integral plus derivative (PID) control.
      1) Include PID algorithms with direct or reverse action and anti-windup.
2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.

3) Controlled variable, set point, and PID gains shall be operator-selectable.

e. Adaptive (automatic tuning).

L. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

M. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

N. Run-Time Totalization:

1. Include software to totalize run-times for all BI and BO points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.17 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in a single enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Do not house more than one controller in a single enclosure.
3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
4. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
5. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spare terminals, equal to not less than 10 percent of used terminals.
7. Include spade lugs for stranded cable and wire.
8. Install a maximum of two wires on each side of a terminal.
9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
11. Mount products within enclosure on removable internal panel(s).
12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch-high lettering.
13. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
14. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
15. Size enclosure internal panel to include at least 25 percent spare area on face of panel.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

D. Wall-Mounted, NEMA 250, Type 1:

1. Enclosure shall be NRTL listed according to UL 50 or UL 50E.
2. Construct enclosure of steel, not less than:
   a. Enclosure size less than 24 in.: 0.053 in. or 0.067 in. thick.
   b. Enclosure size 24 in. and larger: 0.067 in. or 0.093 in. thick.
3. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   a. Exterior color shall be manufacturer's standard.
   b. Interior color shall be manufacturer's standard.
4. Hinged door full size of front face of enclosure and supported using:
   a. Enclosures sizes less than 36 in. tall: Multiple butt hinges.
   b. Enclosures sizes 36 in. tall and larger: Continuous piano hinges.

5. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   a. Size less than 24 in.: Solid or Perforated steel, 0.053 in. thick.
   b. Size 24 in. and larger: Solid aluminum, 0.10 in. or steel, 0.093 in. thick.

6. Internal panel mounting hardware, grounding hardware, and sealing washers.
7. Grounding stud on enclosure body.
8. Thermoplastic pocket on inside of door for record Drawings and Product Data.

E. Wall-Mounted, NEMA 250, Type 4X SS:
1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
4. Construct enclosure of Type 304 stainless steel, not less than the following:
   a. Size Less Than 24 Inches: 0.053 inch thick.
   b. Size 24 Inches and Larger: 0.067 inch thick.

5. Outside body and door of enclosure with brushed No. 4 finish.
6. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.
   a. Sizes through 24 Inches Tall: Two hinges.
   b. Sizes between 24 Inches through 48 Inches Tall: Three hinges.
   c. Sizes Larger 48 Inches Tall: Four hinges.

7. Removable internal panel shall be 0.093-inch solid steel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
8. Internal panel mounting studs and hardware, grounding hardware, and sealing washers.
9. Install corrosion-resistant polyester vent drain in a stainless-steel sleeve at the bottom of enclosure.
10. Include enclosure with stainless-steel mounting brackets.

F. Freestanding, NEMA 250, Type 1:
1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Externally formed body flange around perimeter of enclosure face.
4. Single-door enclosure sizes up to 84 inches tall by 36 inches wide.
5. Double-door enclosure sizes up to 84 inches tall by 72 inches wide.
6. Construct enclosure of steel, not less than 0.067 inch thick.
7. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   a. Exterior color shall be manufacturer's standard.
   b. Interior color shall be manufacturer's standard.
8. Corner-formed flush door, full size of enclosure face, supported using four concealed hinges with easily removable hinge pins.
9. Double-door enclosures with overlapping door design to include unobstructed full-width access.
10. Doors with three-point (top, middle, and bottom) latch system with single heavy-duty handle and integral locking mechanism.
12. Removable solid steel internal panel, 0.093 inch thick, with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
13. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
15. Thermoplastic pocket on inside of door for record Drawings and Product Data.
16. Nominal 4-inch-tall integral lifting base, not less than 0.123 inch thick, with predrilled holes for attachment to mounting surface.
17. Each top end of enclosure fitted with lifting tabs, not less than 0.172 inch thick.
18. Internal rack-mount shelves and angles as required by application.

G. Accessories:

1. Ventilation Fans, Filtered Intake and Exhaust Grilles:
   a. Number and size of fans, filters and grilles as required by application.
   b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
   c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
   d. Thermostatic control with adjustable set point from 32 to 140 deg F.
   e. Airflow Capacity at Zero Pressure:
      1) 4-Inch Fan: 100 cfm.
      2) 6-Inch Fan: 240 cfm.
      3) 10-Inch Fan: 560 cfm.
   f. Maximum operating temperature of 158 deg F.
   g. 4-inch fan thermally protected and provided with permanently lubricated ball-bearings.
   h. 6- and 10-inch fans with ball-bearing construction and split capacitor motors thermally protected to avoid premature failure.
   i. Dynamically balanced impellers molded from polycarbonate material.
   j. Fan furnished with power cord and polarized plug for power connection.
   k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.
   l. Removable Intake and Exhaust Grilles: ABS plastic or stainless steel of size to match fan size and suitable for NEMA 250, Types 1 and 12 enclosures.
m. Filters for NEMA 250, Type 1 Enclosures: Washable foam or aluminum, of a size to match intake grille.

n. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.

2.18 RELAYS

A. General-Purpose Relays:

1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Relays shall have LED indication and a manual reset and push-to-test button.
7. Performance:
   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Pickup Time: 15 ms or less.
   d. Dropout Time: 10 ms or less.
   e. Pull-in Voltage: 85 percent of rated voltage.
   f. Dropout Voltage: 50 percent of nominal rated voltage.
   g. Power Consumption: 2 VA.
   h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a dust-tight cover.
6. Include knob and dial scale for setting delay time.
7. Performance:
   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
   d. Repeatability: Within 2 percent.
e. Recycle Time: 45 ms.
f. Minimum Pulse Width Control: 50 ms.
g. Power Consumption: 5 VA or less at 120-V ac.
h. Ambient Operating Temperatures: Minus 40 to 115 deg F.

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with a multibladed plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Performance:
   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Pickup Time: 15 ms or less.
   d. Dropout Time: 10 ms or less.
   e. Pull-in Voltage: 85 percent of rated voltage.
   f. Dropout Voltage: 50 percent of nominal rated voltage.
   g. Power Consumption: 2 VA.
   h. Ambient Operating Temperatures: Minus 40 to 115 deg F.

7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:

1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:

1. Description:
a. On-off control and status indication in a single device.
b. LED status indication of activated relay and current trigger.
c. Closed-Open-Auto override switch located on the load side of the relay.

2. Performance:
   a. Ambient Temperature: Minus 30 to 140 deg F.

3. Status Indication:
   a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
   b. Current Sensor Range: As required by application.
   c. Current Set Point: Fixed or adjustable as required by application.
   d. Current Sensor Output:
      1) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.

5. Enclosure: NEMA 250, Type 1 enclosure.

2.19 ELECTRICAL POWER DEVICES

A. Transformers:
   1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
   2. Transformer shall be at least 40 VA.
   3. Transformer shall have both primary and secondary fuses.

B. Power-Line Conditioner:
   1. General Power-Line Conditioner Requirements:
      a. Design to ensure maximum reliability, serviceability and performance.
      b. Overall function of the power-line conditioner is to receive raw, polluted electrical power and purify it for use by electronic equipment. The power-line conditioner shall provide isolated, regulated, transient and noise-free sinusoidal power to loads served.
   2. Standards: NRTL listed per UL 1012.
   3. Performance:
      a. Single phase, continuous, 100 percent duty rated KVA/KW capacity. Design to supply power for linear or nonlinear, high crest factor, resistive and reactive loads.
b. Automatically regulate output voltage to within 2 percent or better with input voltage fluctuations of plus 10 to minus 20 percent of nominal when system is loaded 100 percent. Use Variable Range Regulation to obtain improved line voltage regulation when operating under less than full load conditions.

1) At 75 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 35 percent of nominal.
2) At 50 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 40 percent of nominal.
3) At 25 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 45 percent of nominal.

c. With input voltage distortion of up to 40 percent, limit the output voltage sine wave to a maximum harmonic content of 5 percent.

d. Automatically regulate output voltage to within 2.5 percent when load (resistive) changes from zero percent to 100 percent to zero percent.

e. Output voltage returns to 95 percent of nominal level within two cycles and to 100 percent within three cycles when the output is taken from no load to full resistive load or vice-versa. Recovery from partial resistive load changes is corrected in a shorter period of time.

f. K Factor: 30, designed to operate with nonlinear, non-sinusoidal, high crest factor loads without overheating.

g. Input power factor within 0.95 approaching unity with load power factor as poor as 0.6.

h. Attenuate load-generated odd current harmonics 23 dB at the input.

i. Electrically isolate the primary from the secondary. Meet isolation criteria as defined in NFPA 70, Article 250-5D.

j. Lighting and Surge Protection: Compares to UL 1449 rating of 330 V when subjected to Category B3 (6000 V/3000 A) combination waveform as established by IEEE C62.41.

k. Common-mode noise attenuation of 140 dB.

l. Transverse-mode noise attenuation of 120 dB.

m. With loss of input power for up to 16.6 ms, the output sine wave remains at usable ac voltage levels.

n. Reliability of 200,000 hours' MTBF.

o. At full load, when measured at 1-m distance, audible noise is not to exceed 54 dB.

p. Approximately 92 percent efficient at full load.

4. Transformer Construction:

a. Ferroresonant, dry type, convection cooled, 600V class. Transformer windings of Class H (220 deg C) insulated copper.

b. Use a Class H installation system throughout with operating temperatures not to exceed 150 deg C over a 40-deg C ambient temperature.

c. Configure transformer primary for multi-input voltage. Include input terminals for source conductors and ground.
d. Manufacture transformer core using M-6 grade, grain-oriented, stress-relieved transformer steel.
e. Configure transformer secondary in a 240/120-V split with a 208-V tap or straight 120 V, depending on power output size.
f. Electrically isolate the transformer secondary windings from the primary windings. Bond neutral conductor to cabinet enclosure and output neutral terminal.
g. Include interface terminals for output power hot, neutral and ground conductors.
h. Label leads, wires and terminals to correspond with circuit wiring diagram.
i. Vacuum impregnate transformer with epoxy resin.

5. Cabinet Construction:
   a. Design for panel or floor mounting.
   b. NEMA 250, Type 1, general-purpose, indoor enclosure.
   c. Manufacture the cabinet from heavy gauge steel complying with UL 50.
   d. Include a textured baked-on paint finish.

C. Transient Voltage Suppression and High-Frequency Noise Filter Unit:
   1. The maximum continuous operating voltage shall be at least 125 percent.
   2. The operating frequency range shall be 47 to 63 Hz.
   3. Protection modes according to NEMA LS-1.
   4. The rated single-pulse surge current capacity, for each mode of protection, shall be no less than the following:
      a. Line to Neutral: 45,000 A.
      b. Neutral to Ground: 45,000 A.
      c. Line to Ground: 45,000 A.
      d. Per Phase: 90,000 A.

5. Clamping voltages shall be in compliance with test and evaluation procedures defined in NEMA LS-1. Maximum clamping voltage shall be as follows:
   a. Line to Neutral: 360 V.
   b. Line to Ground: 360 V.
   c. Neutral to Ground: 360 V.

6. Electromagnetic interference and RF interference noise rejection or attenuation values shall comply with test and evaluation procedures defined in NEMA LS-1.
   a. Line to Neutral:
      1) 100 kHz: 42 dB.
      2) 1 MHz: 25 dB.
      3) 10 MHz: 21 dB.
      4) 100 MHz: 36 dB.
   
   b. Line to Ground:
      1) 100 kHz: 16 dB.
2) 1 MHz: 55 dB.
3) 10 MHz: 81 dB.
4) 100 MHz: 80 dB.

7. Unit shall have LED status indicator that extinguishes to indicate a failure.
8. Unit shall be listed by an NRTL as a transient voltage surge suppressor per UL 1449, and as an electromagnetic interference filter per UL 1283.
9. Unit shall not generate any appreciable magnetic field.
10. Unit shall not generate an audible noise.

D. DC Power Supply:
1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
2. Enclose circuitry in a housing.
3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
4. Performance:
   a. Output voltage nominally 25-V dc within 5 percent.
   b. Output current up to 100 mA.
   c. Input voltage nominally 120-V ac, 60 Hz.
   d. Load regulation within 0.5 percent from zero- to 100-mA load.
   e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
   f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

2.20 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS FOR WORKSTATIONS
A. 250 through 1000 VA:
1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
   a. Larger-capacity units shall be provided for systems with larger connected loads.
   b. UPS shall provide five minutes of battery power.
3. Performance:
   a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
   b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
   c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
   d. On Battery Output Voltage: Sine wave.
   e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
   f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
g. Transfer Time: 6 ms.
h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.

4. UPS shall be automatic during fault or overload conditions.
5. Unit with integral line-interactive, power condition topology to eliminate all power contaminants.
6. Include front panel with power switch and visual indication of power, battery, fault and temperature.
7. Unit shall include an audible alarm of faults and front panel silence feature.
8. Unit with four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
9. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure).
10. Batteries shall be sealed lead-acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
11. Include tower models installed in ventilated cabinets to the particular installation location.

B. 1000 through 3000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
   a. Larger-capacity units, or multiple units, shall be provided for systems with larger connected loads.
   b. UPS shall provide five minutes of battery power.
3. Performance:
   a. Input Voltage: Single phase, 120-V ac, plus 20 to minus 30 percent.
   b. Power Factor: Minimum 0.97 at full load.
   c. Output Voltage: Single phase, 120-V ac, within 3 percent, steady state with rated output current of 10.0 A, 30.0-A peak.
   d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
   e. Recharge time shall be a maximum of eight hours to 90 percent capacity.
4. UPS bypass shall be automatic during fault or overload conditions.
5. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
6. Batteries shall be sealed lead-acid type and be maintenance free.
7. Include tower models installed in ventilated cabinets or rack models installed on matching racks, as applicable to the particular installation location and space availability/configuration.

2.21 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.
1. Wire size shall be at least No. 18 AWG.
2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be a minimum No. 18 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be a minimum No. 18 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.
3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1. Cable shall be balanced twisted pair.
2. Comply with the following requirements and for balanced twisted pair cable described in Section 26 05 23 "Control-Voltage Electrical Power Cables."
   a. Cable shall be plenum rated.
   b. Cable shall have a unique color that is different from other cables used on Project.

2.22 RACEWAYS

A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.
2.23 OPTICAL FIBER CABLE AND CONNECTORS

A. Comply with requirements in Section 27 13 23 "Communications Optical Fiber Backbone Cabling" for optical fiber backbone cabling and connectors.

B. Comply with requirements in Section 27 15 23 "Communications Optical Fiber Horizontal Cabling" for optical fiber horizontal cabling and connectors.

2.24 ACCESSORIES

A. Pressure Electric Switches:

1. Diaphragm-operated snap acting switch.
2. Set point adjustable from 3 to 20 psig.
3. Differential adjustable from 2 to 6 psig.
4. Rated for resistance loads at 120-V ac.
5. Body and switch housing shall be metal.

B. Damper Blade Limit Switches:

1. Sense positive open and/or closed position of the damper blades.
2. NEMA 250, Type 13, oil-tight construction.
3. Arrange for the mounting application.
4. Additional waterproof enclosure when required by its environment.
5. Arrange to prevent "over-center" operation.

C. I/P and E/P Transducers:

1. Commercial Grade:
   a. The transducer shall convert an AO signal to a stepped pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig pneumatic signal for pneumatic actuation.
   b. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
   c. Transducer shall have auto/manual output switch, manual output control and an output pressure gage.
   d. Accuracy: Within 1.0 percent of the output span.
   e. Linearity: Within 0.5 percent of the output span.
   f. Output Capacity: Not less than 550 scim at 15 psig.
   g. Transducer shall have separate zero and span calibration adjustments.
   h. The transducer shall withstand up to 40 psig of supply pressure without damage.

D. E/P Switch:
1. Construct the body of cast aluminum or brass; three pipe body (common, normally open, and normally closed).
2. Internal construction of steel, copper or brass.
3. Air Connections: Barb.
4. Rating of 30 psig when installed in systems below 25 psig and of 150 psig when installed in systems above 25 psig.
5. Include coil transient suppression.

E. Instrument Enclosures:

1. Include instrument enclosure for secondary protection to comply with requirements indicated in "Performance Requirements" Article.
2. NRTL listed and labeled to UL 50.
3. Sized to include at least 25 percent spare area on subpanel.
4. Instrument(s) mounted within enclosure on internal subpanel(s).
5. Enclosure face with engraved, laminated phenolic nameplate for each instrument within enclosure.
6. Enclosures housing pneumatic instruments shall include main pressure gage and a branch pressure gage for each pneumatic device, installed inside.
7. Enclosures housing multiple instruments shall route tubing and wiring within enclosure in a raceway having a continuous removable cover.
8. Enclosures larger than 12 inches shall have a hinged full-size face cover.

F. Manual Valves:

1. Needle Type:
   a. PTFE packing.
   b. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless-steel tubing.
   c. Aluminum T-bar handle.
   d. Include tubing connections.
2. Ball Type:
   b. Ball: Type 316 stainless steel.
   c. Stem: Type 316 stainless steel.
   d. Seats: Reinforced PTFE.
   e. Packing Ring: Reinforced PTFE.
   f. Lever: Stainless steel with a vinyl grip.
   g. 600 WOG.
   h. Threaded end connections.

G. Wall-Mounted Portable Workstation Cabinet:

1. Surface-mounted wall cabinet for tilt-out operation of laptop computers and large-format mobile devices.
2. Cabinet shall have a load limit of 50 lb.
3. Cabinet shall include the following:
a. Oil-filled dampers for controlled lowering of equipment to operational position.
b. 3RU EIA mounting rails.
c. Removable laptop shelf.
d. Separate top compartment with mounting area, hinged rail and security lock.
e. Front ventilation slots.
f. Knockouts for conduit connections on top and bottom of cabinet.

4. Cabinet shall be constructed of steel and painted with a powder-coat epoxy.
5. Inside center of backbox shall have provision to mount a field-furnished and -installed, single gang electrical outlet box.

2.25 IDENTIFICATION

A. Instrument Air Pipe and Tubing:
   1. Engraved tag shall bear the following information:
      a. Service (Example): "Instrument Air."
      b. Pressure Range (Example): 0 to 30 psig.
   2. Letter size shall be a minimum of 0.25 inch high.
   3. Tag shall consist of white lettering on blue background.
   4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded blue with contrasting white center exposed by engraving through outer layer.
   5. Include tag with a brass grommet, chain and S-hook.

B. Control Equipment, Instruments, and Control Devices:
   1. Laminated acrylic or melamine plastic sign bearing unique identification.
      a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.
   2. Letter size shall be as follows:
      a. Operator Workstations: Minimum of 0.5 inch high.
      b. Servers: Minimum of 0.5 inch high.
      c. Printers: Minimum of 0.5 inch high.
      d. DDC Controllers: Minimum of 0.5 inch high.
      e. Gateways: Minimum of 0.5 inch high.
      f. Repeaters: Minimum of 0.5 inch high.
      g. Enclosures: Minimum of 0.5 inch high.
      h. Electrical Power Devices: Minimum of 0.25 inch high.
      i. UPS units: Minimum of 0.5 inch high.
      j. Accessories: Minimum of 0.25 inch high.
      k. Instruments: Minimum of 0.25 inch high.
      l. Control Damper and Valve Actuators: Minimum of 0.25 inch high.
3. Legend shall consist of white lettering on black background.
4. Laminated acrylic or melamine plastic sign shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer and shall be fastened with drive pins.
5. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.

C. Valve Tags:
   1. Brass tags and brass chains attached to valve.
   2. Tags shall be at least 1.5 inches in diameter.
   3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three-digit sequential number. For example: TV-1.001.
   4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

D. Raceway and Boxes:
   1. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
   2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.
   3. For raceways housing pneumatic tubing, add a phenolic tag labeled "HVAC Instrument Air Tubing."
   4. For raceways housing air signal tubing, add a phenolic tag labeled "HVAC Air Signal Tubing."

E. Equipment Warning Labels:
   1. Self-adhesive label with pressure-sensitive adhesive back and peel-off protective jacket.
   2. Lettering size shall be at least 14-point type with white lettering on red background.
   3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
   4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

2.26 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate the following according to industry standards for each product, and to verify DDC system reliability specified in performance requirements:
   1. DDC controllers.
2. Gateways.
3. Routers.
4. Operator workstations.

B. Product(s) and material(s) will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.
2. Equipment to Be Connected:
   a. Fan Coil Units specified in Section 23 82 19 “Fan Coil Units”
   b. Variable-frequency controllers specified in Section 26 29 23 "Variable-Frequency Motor Controllers."

B. Communication Interface to Other Building Systems:

1. DDC system shall have a communication interface with systems having a communication interface.
3.3 DDC SYSTEM INTERFACE WITH EXISTING SYSTEMS

A. Interface with Existing Systems:

1. DDC systems shall interface existing systems to achieve integration.
2. Monitoring and Control of DDC System by Existing Control System:
   a. DDC system performance requirements shall be satisfied when monitoring and controlling DDC system by existing control system.
   b. Operator of existing system shall be able to upload, download, monitor, trend, control and program every input and output point in DDC system from existing control system using existing control system software and operator workstations.
   c. Remote monitoring and control from existing control system shall not require operators of existing control system to learn new software.
   d. Interface of DDC system into existing control system shall be transparent to operators of existing control system and allow operators to monitor and control DDC system from any operator workstation connected to existing control system.

3. Integration of Existing Control System into DDC System:
   a. Existing control system performance requirements shall be satisfied when monitoring and controlling existing control system through DDC system.
   b. Operator shall be able to upload, download, monitor, alarm, report, trend, control and program every input and output point in existing system from DDC system using operator workstations and software provided. The combined systems shall share one database.
   c. Interface of existing control system I/O points into DDC system shall be transparent to operators. All operational capabilities shall be identical regardless of whether I/O already exists or I/O is being installed.

B. Integration with Existing Enterprise System:

1. DDC system shall interface with an existing enterprise system to adhere to Owner standards already in-place and to achieve integration.
2. Owner's control system integrator will provide the following services:
   a. Enterprise system expansion and development of graphics, logs, reports, trends and other operational capabilities of enterprise system for I/O being added to DDC control system for use by enterprise system operators.
   b. Limited assistance during commissioning to extent of DDC system integration with existing enterprise system.
   c. Prepare on-site demonstration mockup of integration of DDC system to be installed with existing system before installing DDC system.

3. Engage Owner's control system integrator to provide the following services:
   a. Enterprise system expansion and development of graphics, logs, reports, trends and other operational capabilities of enterprise system for I/O being added to DDC control system for use by enterprise system operators.
b. Limited assistance during commissioning to extent of DDC system integration with existing enterprise system.
c. Prepare on-site demonstration mockup of integration of DDC system to be installed with existing system before installing DDC system.

4. Attend meetings with control system integrator to integrate DDC system.

3.4 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control valves, which are specified in Section 23 09 23.11 "Control Valves."
2. Pipe-mounted sensors, switches and transmitters. Liquid temperature sensors, switches, and transmitters.

3.5 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION

A. Deliver the following to air-handling unit manufacturer for factory installation. Include installation instructions to air-handling unit manufacturer.

1. Programmable application or application-specific controller.
2. Unit-mounted DDC control dampers and actuators.
3. Unit-mounted airflow sensors, switches and transmitters.
4. Unit-mounted gas sensors and transmitters.
5. Unit-mounted pressure sensors, switches and transmitters.
6. Unit-mounted temperature sensors, switches and transmitters.
7. Relays.

B. Deliver the following to terminal unit manufacturer for factory installation. Include installation instructions to terminal unit manufacturer.

1. Programmable application or application-specific controller.
2. Electric damper actuator.
3. Unit-mounted flow and pressure sensors, transmitters and transducers.
4. Unit-mounted temperature sensors.
5. Relays.

C. Deliver the following to fan-coil unit manufacturer for factory installation. Include installation instructions to fan-coil unit manufacturer.
1. Programmable application or application-specific controller.
2. Unit-mounted temperature sensors.
4. Relays.

3.6 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.
B. Install products level, plumb, parallel, and perpendicular with building construction.
C. Support products, tubing, piping wiring and raceways.
D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.
E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
F. Firestop Penetrations Made in Fire-Rated Assemblies: Comply with requirements in Section 07 84 13 "Penetration Firestopping."
G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 07 92 00 "Joint Sealants."
H. Welding Requirements:
   1. Restrict welding and burning to supports and bracing.
   2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
   3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
   4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.
I. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.
J. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.
3.7 GATEWAY INSTALLATION
   A. Install gateways if required for DDC system communication interface requirements indicated.
      1. Install gateway(s) required to suit indicated requirements.
   B. Test gateway to verify that communication interface functions properly.

3.8 ROUTER INSTALLATION
   A. Install routers if required for DDC system communication interface requirements indicated.
      1. Install router(s) required to suit indicated requirements.
   B. Test router to verify that communication interface functions properly.

3.9 CONTROLLER INSTALLATION
   A. Install controllers in enclosures to comply with indicated requirements.
   B. Connect controllers to field power supply and to UPS units where indicated.
   C. Install controller with latest version of applicable software and configure to execute requirements indicated.
   D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.
   E. Installation of Network Controllers:
      1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
      2. Install controllers in a protected location that is easily accessible by operators.
      3. Top of controller shall be within 72 inches of finished floor.
   F. Installation of Programmable Application Controllers:
      1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
      2. Install controllers in a protected location that is easily accessible by operators.
      3. Top of controller shall be within 72 inches of finished floor.
   G. Application-Specific Controllers:
      1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
      2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.
3.10 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Electrical power devices.
5. UPS units.
6. Relays.
7. Accessories.
8. Instruments.
9. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use painted steel strut and hardware.
2. For NEMA 250, Type 4X Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top of adjacent enclosures of like size.

D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using galvanized-steel anchors.

E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.11 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.
3.12 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for identification products and installation.

B. Install laminated acrylic or melamine plastic signs with unique identification on face for each of the following:
   1. Gateway.
   2. Router.
   4. DDC controller.
   5. Enclosure.
   6. Electrical power device.
   7. UPS unit.
   8. Accessory.

C. Install unique instrument identification on face of each instrument connected to a DDC controller.

D. Install unique identification on face of each control damper and valve actuator connected to a DDC controller.

E. Where product is installed above accessible tile ceiling, also install matching identification on face of ceiling grid located directly below.

F. Where product is installed above an inaccessible ceiling, also install identification on face of access door directly below.

G. Warning Labels and Signs:
   1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
   2. Shall be located in highly visible location near power service entry points.

3.13 NETWORK INSTALLATION

A. Install optical fiber cable when connecting between the following network devices and when located in different buildings on campus, or when distance between devices exceeds 50 feet:
   1. Operator workstations.
   2. Operator workstations and network controllers.
   3. Network controllers.

B. Install balanced twisted pair or optical fiber cable when connecting between the following network devices located in same building:
   1. Operator workstations.
   2. Operator workstations and network controllers.
3. Network controllers.

C. Install balanced twisted pair or copper cable (as required by equipment) when connecting between the following:

1. Gateways.
2. Gateways and network controllers or programmable application controllers.
3. Routers.
4. Routers and network controllers or programmable application controllers.
5. Network controllers and programmable application controllers.
6. Programmable application controllers.
7. Programmable application controllers and application-specific controllers.

D. Install cable in continuous raceway.

1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.14 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:

1. MAC Address:
   a. Every network device shall have an assigned and documented MAC address unique to its network.
   b. Ethernet Networks: Document MAC address assigned at its creation.
   c. ARCNET or MS/TP networks: Assign from 00 to 64.

2. Network Numbering:
   a. Assign unique numbers to each new network.
   b. Provide ability for changing network number through device switches or operator interface.
   c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3. Device Object Identifier Property Number:
   a. Assign unique device object identifier property numbers or device instances for each device network.
   b. Provide for future modification of device instance number by device switches or operator interface.
   c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:
a. Device object name property field shall support 32 minimum printable characters.
b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".

5. Object Name Property Text for Other Than Device Objects:

a. Object name property field shall support 32 minimum printable characters.
b. Assign object name properties with plain-English names descriptive of application.

1) Example 1: "Zone 1 Temperature."
2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:

a. Assign object identifier property numbers according to Drawings or tables indicated.
b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.15 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Wire and Cable Installation:

1. Comply with installation requirements in Section 26 05 23 "Control-Voltage Electrical Power Cables."
2. Comply with installation requirements in Section 27 13 13 "Communications Copper Backbone Cabling."
3. Comply with installation requirements in Section 27 15 13 "Communications Copper Horizontal Cabling."
4. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
   a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

5. Terminate wiring in a junction box.

a. Clamp cable over jacket in junction box.
b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.
6. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
7. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
8. Use shielded cable to transmitters.
9. Use shielded cable to temperature sensors.
10. Perform continuity and meager testing on wire and cable after installation.

C. Conduit Installation:
1. Comply with Section "260533 "Raceways and Boxes for Electrical Systems" for control-voltage conductors.
2. Comply with Section 27 05 28 "Pathways for Communications Systems" for balanced twisted pair cabling and optical fiber installation.

3.16 OPTICAL FIBER CABLE SYSTEM INSTALLATION
A. Comply with installation requirements in Section 27 13 23 "Communications Optical Fiber Backbone Cabling."
B. Comply with installation requirements in Section 27 15 23 "Communications Optical Fiber Horizontal Cabling."

3.17 FIELD QUALITY CONTROL
A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Testing of Pneumatic and Air-Signal Tubing:
      a. Test for leaks and obstructions.
      b. Disconnect each pipe and tubing line before a test is performed, and blowout dust, dirt, trash, condensate and other foreign materials with compressed air. Use commercially pure compressed air or nitrogen as distributed in gas cylinders. Air from an oil-free compressor with an air dryer is an acceptable alternative for the test.
      c. After foreign matter is expelled and line is free from obstructions, plug far end of tubing run.
d. Connect a pressure source to near end of run with a needle valve between air supply and tubing run.
e. Connect a pressure gage accurate to within 0.5 percent of test between the shutoff needle valve and tubing run under test.
f. For system pressures above 30 psig, apply a pressure of 1.5 times operating pressure. Record pressure in tubing run every 10 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 1 psig.
g. For system pressures 30 psig and below, apply a pressure of 2.0 times operating pressure to piping and tubing run. Record pressure in tubing run every 5 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 0.5 psig.

D. Testing:
   1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
   2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
   3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
   4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
   5. Test Equipment: Use an optical fiber time domain reflectometer for testing of length and optical connectivity.
   6. Test Results: Record test results and submit copy of test results for Project record.

3.18 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.
B. Check instruments for proper location and accessibility.
C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.
E. For pneumatic products, verify that air supply for each product is properly installed.
F. Control Damper Checkout:
1. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
2. Verify that control dampers are installed correctly for flow direction.
3. Verify that proper blade alignment, either parallel or opposed, has been provided.
4. Verify that damper blade travel is unobstructed.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that damper frame attachment is properly secured and sealed.
7. Verify that actuator linkage attachment is secure.
8. Verify that control valves are installed correctly for flow direction.
9. Verify that valve body attachment is properly secured and sealed.
10. Verify that valve actuator and linkage attachment is secure.
11. Verify that valve ball, disc or plug travel is unobstructed.
12. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

G. Control Valve Checkout:

1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
2. Verify that control valves are installed correctly for flow direction.
3. Verify that valve body attachment is properly secured and sealed.
4. Verify that valve actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that actuator wiring is complete, enclosed and connected to correct power source.
7. Verify that valve ball, disc or plug travel is unobstructed.
8. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

H. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:
   a. Verify sensing element type and proper material.
   b. Verify length and insertion.

3.19 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.

G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

J. Analog Signals:
   1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
   2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
   3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:
   1. Check digital signals using a jumper wire.
   2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:
   1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
   2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
   3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
   4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:
   1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
P. Switches: Calibrate switches to make or break contact at set points indicated.
Q. Transmitters:
   1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
   2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.20 DDC SYSTEM CONTROLLER CHECKOUT
A. Verify power supply.
   1. Verify voltage, phase and hertz.
   2. Verify that protection from power surges is installed and functioning.
   3. Verify that ground fault protection is installed.
   4. If applicable, verify if connected to UPS unit.
   5. If applicable, verify if connected to a backup power source.
   6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.
B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
C. Verify that spare I/O capacity is provided.

3.21 DDC CONTROLLER I/O CONTROL LOOP TESTS
A. Testing:
   1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
   2. Test every I/O point throughout its full operating range.
   3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.

5. Test and adjust every control loop for proper operation according to sequence of operation.

6. Test software and hardware interlocks for proper operation. Correct deficiencies.

7. Operate each analog point at the following:
   a. Upper quarter of range.
   b. Lower quarter of range.
   c. At midpoint of range.

8. Exercise each binary point.

9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.

10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.22 DDC SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.

B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.
5. Installed DDC system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. DDC system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller's programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.
15. Each control damper and actuator goes to failed position on loss of power.
16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.
22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

E. Test Plan:
1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 10 business days before start of tests.

F. Validation Test:
1. Verify operating performance of each I/O point in DDC system.
   a. Verify analog I/O points at operating value.
   b. Make adjustments to out-of-tolerance I/O points.
      1) Identify I/O points for future reference.
      2) Simulate abnormal conditions to demonstrate proper function of safety devices.
      3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.
2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:
   a. Re-check I/O points that required corrections during initial test.
   b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.
5. After 24 Hours of Second Validation Test:
   a. Re-check I/O points that required corrections during second test.
b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.

7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. DDC System Response Time Test:

1. Simulate HLC.
   a. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.

2. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.

3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.

4. Purpose of test is to demonstrate DDC system, as follows:
   a. Reaction to COV and alarm conditions during HLC.
   b. Ability to update DDC system database during HLC.

5. Passing test is contingent on the following:
   a. Alarm reporting at printer beginning no more than two seconds after the initiation (time zero) of HLC.
   b. All alarms, both binary and analog, are reported and printed; none are lost.
   c. Compliance with response times specified.

6. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.

H. DDC System Network Bandwidth Test:

1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.

2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.23 DDC SYSTEM WIRELESS NETWORK VERIFICATION

A. DDC system Installer shall design wireless DDC system networks to comply with performance requirements indicated.

B. Installer shall verify wireless network performance through field testing and shall document results in a field test report.
C. Testing and verification of all wireless devices shall include, but not be limited to, the following:

1. Speed.
2. Online status.
3. Signal strength.

3.24 FINAL REVIEW

A. Submit written request to Architect and Construction Manager when DDC system is ready for final review. Written request shall state the following:

1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Review by Architect and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals when no deficiencies are reported.

F. A part of DDC system final review shall include a demonstration to parties participating in final review.

1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:

   a. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 10 I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.

c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.

d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.

e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.

f. Trends, summaries, logs and reports set-up for Project.

g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.

h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.

i. Software's ability to edit control programs off-line.

j. Data entry to show Project-specific customizing capability including parameter changes.

k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.

l. Execution of digital and analog commands in graphic mode.

m. Spreadsheet and curve plot software and its integration with database.

n. Online user guide and help functions.

o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.

p. System speed of response compared to requirements indicated.

q. For Each Network and Programmable Application Controller:

   1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.

   2) Operator Interface: Ability to connect directly to each type of digital controller with a portable workstation and mobile device. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.

   3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.

   4) Electric Power: Ability to disconnect any controller safely from its power source.

   5) Wiring Labels: Match control drawings.

   6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.

   7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.
r. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Use ASHRAE 135 protocol analyzer to help identify devices, view network traffic, and verify interoperability. Requirements must be met even if only one manufacturer's equipment is installed.

1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:
   a) Display of network device status.
   b) Display of BACnet Object Information.
   c) Silencing devices transmitting erroneous data.
   d) Time synchronization.
   e) Remote device re-initialization.
   f) Backup and restore network device programming and master database(s).
   g) Configuration management of routers.

3.25 EXTENDED OPERATION TEST

A. Extended operation test is intended to simulate normal operation of DDC system by Owner.

B. Operate DDC system for an operating period of 14 consecutive calendar days following Substantial Completion. Coordinate exact start date of testing with Owner.

C. Provide an operator familiar with DDC system installed to man an operator workstation while on-site during eight hours of each normal business day occurring during operating period.
D. During operating period, DDC system shall demonstrate correct operation and accuracy of monitored and controlled points as well as operation capabilities of sequences, logs, trends, reports, specialized control algorithms, diagnostics, and other software indicated.

1. Correct defects of hardware and software when it occurs.

E. Definition of Failures and Downtime during Operating Period:

1. Failed I/O point constituting downtime is an I/O point failing to perform its intended function consistently and a point physically failed due to hardware and software.
2. Downtime is when any I/O point in DDC system is unable to fulfill its' required function.
3. Downtime shall be calculated as elapsed time between a detected point failure as confirmed by an operator and time point is restored to service.
4. Maximum time interval allowed between DDC system detection of failure occurrence and operator confirmation shall be 0.5 hours.
5. Downtime shall be logged in hours to nearest 0.1 hour.
6. Power outages shall not count as downtime, but shall suspend test hours unless systems are provided with UPS and served through a backup power source.
7. Hardware or software failures caused by power outages shall count as downtime.

F. During operating period, log downtime and operational problems are encountered.

1. Identify source of problem.
2. Provide written description of corrective action taken.
3. Record duration of downtime.
4. Maintain log showing the following:
   a. Time of occurrence.
   b. Description of each occurrence and pertinent written comments for reviewer to understand scope and extent of occurrence.
   c. Downtime for each failed I/O point.
   d. Running total of downtime and total time of I/O point after each problem has been restored.

5. Log shall be available to Owner for review at any time.

G. For DDC system to pass extended operation test, total downtime shall not exceed 2 percent of total point-hours during operating period.

1. Failure to comply with minimum requirements of passing at end of operating period indicated shall require that operating period be extended one consecutive day at a time until DDC system passes requirement.

H. Evaluation of DDC system passing test shall be based on the following calculation:

1. Downtime shall be counted on a point-hour basis where total number of DDC system point-hours is equal to total number of I/O points in DDC system multiplied by total number of hours during operating period.
2. One point-hour of downtime is one I/O point down for one hour. Three points down for five hours is a total of 15 point-hours of downtime. Four points down for one-half hour is 2 point-hours of downtime.

3. Example Calculation: Maximum allowable downtime for 30-day test when DDC system has 1000 total I/O points (combined analog and binary) and has passing score of 1 percent downtime is computed by 30 days x 24 h/day x 1000 points x 1 percent equals 7200 point-hours of maximum allowable downtime.

I. Prepare test and inspection reports.

3.26 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.27 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by DDC system manufacturer's authorized service representative. Include semiannual preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.28 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two year(s).

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two year(s) from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

3.29 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:
1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:
   a. Provide not less than five days of training total.
   b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
   c. Total days of training shall be broken into not more than three separate training classes.
   d. Each training class shall be not less than two consecutive day(s).

C. Training Schedule:
1. Schedule training with Owner 20 business days before expected Substantial Completion.
2. Schedule training to provide Owner with at least 10 business days of notice in advance of training.
3. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions. Each morning session and afternoon session shall be split in half with 15-minute break between sessions. Morning and afternoon sessions shall be separated by 30-minute lunch period. Training, including breaks and excluding lunch period, shall not exceed eight hours per day.
4. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:
1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Training Attendee Headcount:
1. Plan in advance of training for two attendees.
2. Make allowance for Owner to add up to two attendee(s) at time of training.
3. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.
F. Training Attendee Prior Knowledge: For guidance in planning required training and instruction, assume attendees have the following:

1. Intermediate user knowledge of computers and office applications.
2. Intermediate knowledge of HVAC systems.
3. Intermediate knowledge of DDC systems.
4. Intermediate knowledge of DDC system and products installed.

G. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

H. Instructor Requirements:

1. One or multiple qualified instructors, as required, to provide training.
2. Instructors shall have not less than five years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

I. Organization of Training Sessions:

1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:
   a. Daily operators.
   b. Advanced operators.
   c. System managers and administrators.
2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

J. Training Outline:

1. Submit training outline for Owner review at least 10 business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

K. On-Site Training:
1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

L. Off-Site Training:

1. Provide conditioned training rooms and workspace with ample tables desks or tables, chairs, power and data connectivity for each attendee.
2. Provide capability to remotely access to Project DDC system for use in training.
3. Provide a workstation for use by each attendee.

M. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
18. Executing digital and analog commands in graphic mode.
19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:
   a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
   b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.
   c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
   d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
   e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
   f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
   g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

N. Training Content for Advanced Operators:

1. Making and changing workstation graphics.
2. Creating, deleting and modifying alarms including annunciation and routing.
3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
4. Creating, deleting and modifying reports.
5. Creating, deleting and modifying points.
6. Creating, deleting and modifying programming including ability to edit control programs off-line.
7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.
12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
15. Adjusting, calibrating and replacing DDC system components.

O. Training Content for System Managers and Administrators:
1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

P. Video of Training Sessions:

1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

END OF SECTION 23 09 23
SECTION 23 09 23.11 - CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control valves and actuators for DDC systems.

B. Related Requirements:

   1. Section 23 09 23 "Direct-Digital Control System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

   1. Include diagrams for power, signal, and control wiring.
   2. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

   1. Schedule and design calculations for control valves and actuators, including the following:

      a. Flow at project design and minimum flow conditions.
      b. Pressure differential drop across valve at project design flow condition.
      c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
      d. Design and minimum control valve coefficient with corresponding valve position.
      e. Maximum close-off pressure.
      f. Leakage flow at maximum system pressure differential.
      g. Torque required at worst case condition for sizing actuator.
      h. Actuator selection indicating torque provided.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional, as defined in Section 01 40 00 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Determine control valve sizes and flow coefficients by ISA 75.01.01.

F. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

G. Selection Criteria:
   1. Control valves shall be suitable for operation at following conditions:
      a. Chilled Water: 50 psi and 40 F
      b. Heating Hot Water: 50 psi and 200 F
   2. Fail positions unless otherwise indicated:
      a. Chilled Water: Close
      b. Heating Hot Water: Open.
   3. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
   4. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.
   5. Modulating valve sizes for steam service shall provide a pressure drop at design flow equal to lesser of the following:
      a. 50 percent of the valve inlet pressure.
      b. 50 percent of the absolute steam pressure at the valve inlet.

2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:
   1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
   2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
   4. Process Temperature Range: Zero to 212 deg F.
7. Ball: Chrome-plated brass or bronze or 300 series stainless steel.
8. Stem and Stem Extension:
   a. Material to match ball.
   b. Blowout-proof design.
   c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.

B. Ball Valves with Two Ports and Characterized Disk:
1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
4. Process Temperature Range: Zero to 212 deg F.
7. Ball: Chrome-plated brass or bronze or 300 series stainless steel.
8. Stem and Stem Extension:
   a. Material to match ball.
   b. Blowout-proof design.
   c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
12. Flow Characteristics for B-Port: Modified for constant common port flow.

2.3 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

B. Actuators for Steam Control Valves: Shutoff against 1.5 times steam design pressure.
C. Position indicator and graduated scale on each actuator.

D. Type: Motor operated, with or without gears, electric and electronic.

E. Voltage: -24 V ac 120-V ac.

F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

G. Function properly within a range of 85 to 120 percent of nameplate voltage.

H. Construction:
   1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
   2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
   3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

I. Field Adjustment:
   1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
   2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

J. Two-Position Actuators: Single direction, spring return or reversing type.

K. Modulating Actuators:
   1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
   2. Control Input Signal:
      a. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.

L. Fail-Safe:
   1. Where indicated, provide actuator to fail to an end position.
   2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
   3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

M. Integral Overload Protection:
   1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

N. Valve Attachment:
   1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
   2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
   3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

O. Temperature and Humidity:
   1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F
   2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

P. Enclosure:
   1. Suitable for ambient conditions encountered by application.
   2. NEMA 250, Type 2 for indoor and protected applications.
   3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
   4. Provide actuator enclosure with heater and control where required by application.

Q. Stroke Time:
   1. Operate valve from fully closed to fully open within 60 seconds.
   2. Operate valve from fully open to fully closed within 60 seconds.
   3. Move valve to failed position within 15 seconds.
   4. Select operating speed to be compatible with equipment and system operation.

R. Sound:
   1. Spring Return: 62 dBA.
   2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL
   A. Furnish and install products required to satisfy most stringent requirements indicated.
   B. Install products level, plumb, parallel, and perpendicular with building construction.
C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 50 lbs force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:
1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

H. Corrosive Environments:
1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:
   a. Laboratory exhaust airstreams.
   b. Process exhaust airstreams.
3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.2 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.3 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve.

D. Install pressure temperature taps in piping upstream and downstream of each control valve.

E. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
2. Install valves in a position to allow full stem movement.
3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

F. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

G. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

H. Flanged Valves:

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
I. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

J. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

K. Install engraved phenolic nameplate with valve identification on valve

3.4 CHECKOUT PROCEDURES

A. Control Valve Checkout:
   1. Check installed products before continuity tests, leak tests, and calibration.
   2. Check valves for proper location and accessibility.
   3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
   4. For pneumatic products, verify air supply for each product is properly installed.
   5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
   6. Verify that control valves are installed correctly for flow direction.
   7. Verify that valve body attachment is properly secured and sealed.
   8. Verify that valve actuator and linkage attachment are secure.
   9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
  10. Verify that valve ball, disc, and plug travel are unobstructed.
  11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.5 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 23.11
SECTION 23 09 23.12 - CONTROL DAMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Control dampers and actuators for DDC systems.

B. Related Requirements:
   1. Section 23 09 23 "Direct Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Selection Criteria:
   1. Control dampers shall be suitable for operation at following conditions:
      a. Supply Air: 4” w.g. @ 120 F
      b. Return Air: 2” w.g. @ 120 F
c. Outdoor Air: 4” w.g. @ 120 F  
d. Mixed Air: 4” w.g. @ 120 F  
e. Exhaust Air: 2” w.g. @ 120 F

2. Fail positions unless otherwise indicated:
   a. Supply Air: Open.  
b. Return Air: Open.  
c. Outdoor Air: Close.  
d. Mixed Air: Open.  
e. Exhaust Air: Close.

3. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.

2.2 RECTANGULAR CONTROL DAMPERS

A. General Requirements:
   1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.  
   2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.

B. Rectangular Dampers with Aluminum Airfoil Blades:
   1. Performance:
      a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.  
      b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.  
      c. Velocity: Up to 6000 fpm.  
      d. Temperature: Minus 40 to plus 185 deg F.  
      e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.  
      f. Damper shall have AMCA seal for both air leakage and air performance.
   2. Construction:
      a. Frame:
         1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.  
         2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.  
         3) Width not less than 5 inches.  
      b. Blades:
1) Hollow, airfoil, extruded aluminum.
2) Parallel or opposed blade configuration as required by application.
3) Material: ASTM B211, Alloy 6063 T5 aluminum, 0.07 inch thick.
4) Width not to exceed 6 inches.
5) Length as required by close-off pressure, not to exceed 48 inches.

**c. Seals:**

1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
2) Jambs: Stainless steel, compression type.

**d. Axles:** 0.5-inch-diameter platedsteel, mechanically attached to blades.

**e. Bearings:**

1) Molded synthetic or stainless steel sleeve mounted in frame.
2) Where blade axles are installed in vertical position, provide thrust bearings.

**f. Linkage:**

1) Concealed in frame.
2) Constructed of aluminum and plated steel.
3) Hardware: Stainless steel.

**g. Transition:**

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.
6) stainless steel.

### 2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

**A.** Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

**B.** Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

**C.** The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail in desired position in the event of a power failure.

I. Actuator Fail Positions: See Drawings.

2.4 ELECTRIC AND ELECTRONIC CONTROL DAMPER ACTUATORS

A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:

1. 24 V.
2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Modulating Actuators:
1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:
   a. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.

G. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

H. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

I. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

J. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

K. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with a heater and controller where required by application.

L. Stroke Time:

1. Operate damper from fully closed to fully open within 60 seconds.
2. Operate damper from fully open to fully closed within 60 seconds.
3. Move damper to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

M. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 CONTROL-DAMPER APPLICATIONS

A. Control Dampers:

B. Select from damper types indicated in "Control Dampers" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

1. Rectangular Exhaust Air Duct Applications with SMACNA Construction Class A and Velocities to 2,000 FPM Rectangular dampers with aluminum flat blades.
2. Round Exhaust Air Duct Applications with SMACNA Construction Class A and Velocities to 2,000 FPM Rectangular dampers with aluminum flat blades.
3. Rectangular Outdoor Air Duct Applications with SMACNA Construction Class A and Velocities to 2,000 FPM Rectangular dampers with aluminum flat blades.
4. Round Outdoor Air Duct Applications with SMACNA Construction Class A and Velocities to 2,000 FPM Rectangular dampers with aluminum flat blades.
5. Rectangular Return Air Duct Applications with SMACNA Construction Class A and Velocities to 2,000 FPM Rectangular dampers with aluminum flat blades.
6. Round Return Air Duct Applications with SMACNA Construction Class A and Velocities to 2,000 FPM Rectangular dampers with aluminum flat blades.
7. Rectangular Supply Air Duct Applications with SMACNA Construction Class A and Velocities to 2,000 FPM Rectangular dampers with aluminum flat blades.
8. Round Supply Air Duct Applications with SMACNA Construction Class A and Velocities to 2,000 FPM Rectangular dampers with aluminum flat blades.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 50 lb force.

C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:
   1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL DAMPERS

A. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

B. Clearance:
   1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
   2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

C. Service Access:
   1. Dampers and actuators shall be accessible for visual inspection and service.
   2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 23 33 00 "Air Duct Accessories."
D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

E. Attach actuator(s) to damper drive shaft.

F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

G. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

H. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

I. Install engraved phenolic nameplate with damper identification on damper

3.5 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Verify that control dampers are installed correctly for flow direction.
4. Verify that proper blade alignment, either parallel or opposed, has been provided.
5. Verify that damper frame attachment is properly secured and sealed.
6. Verify that damper actuator and linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. Verify that damper blade travel is unobstructed.

3.6 ADJUSTMENT, CALIBRATION, AND TESTING:

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

C. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 23.12
SECTION 23 09 23.23 - PRESSURE INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Liquid-pressure switches.
   2. Liquid-pressure transmitters.

B. Related Requirements:
   1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 LIQUID-PRESSURE SWITCHES

A. Liquid Gage Pressure Switch, Diaphragm Operated, Low Pressure:
1. Description:
   a. Diaphragm operated to actuate an SPDT snap switch.
   b. Electrical Connections: Screw terminal.
   c. Enclosure Conduit Connection: Knock out or threaded connection.
   d. User Interface: External screw with visual set-point adjustment.
   f. Enclosure:
      1) Dry Indoor Installations: NEMA 250, Type 1.
      2) Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
      3) Hazardous Environments: Explosion proof.

2. Operating Data:
   a. Electrical Rating: 15 A at 120-V ac.
   b. Pressure Limits:
      1) Range 1 to 30 psig (7 to 207 kPa): 60 psig (414 kPa).
      2) Range 10 to 125 psig (69 to 862 kPa): 160 psig (1103 kPa).
   c. Temperature Limits: Minus 30 to 150 deg F (Minus 35 to 66 deg C).
   d. Operating Range: [1 to 30 psig (7 to 207 kPa)] [10 to 250 psig (69 to 862 kPa)].
   e. Deadband: Fixed.

3. Pressure Chamber Material: Stainless steel.
4. Diaphragm Material: PTFE.

B. Liquid-Pressure Differential Switch with Set-Point Indicator:

1. Description:
   a. Type 316 stainless steel double opposing bellows operate to actuate a SPDT snap switch.
   b. Electrical Connections: Screw terminal.
   c. Enclosure Conduit Connection: Knock out or threaded connection.
   d. User Interface: Thumbscrew set-point adjustment with enclosed set-point indicator and scale.
   e. High and Low Process Connections: Threaded, NPS 1/8 (DN 3).
   f. Enclosure:
      1) Dry Indoor Installations: NEMA 250, Type 1.
      2) Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
      3) Hazardous Environments: Explosion proof.
   g. Operating Data:
      1) Electrical Rating: 15 A at 120- to 240-V ac.
      2) Pressure Limits: At least 5 times full-scale range, but not less than system design pressure rating.
2.2 LIQUID-PRESSURE TRANSMITTERS

A. Liquid-Pressure Differential Transmitter:

1. Performance:
   a. Range: Approximately 2 times set point.
   b. Span: Adjustable plus or minus one milliamp, noninteractive.
   c. Accuracy: Within 0.25 percent of full scale.
   d. Pressure: Maximum operating pressure 2.5 times range.
   e. Temperature Limits: Zero to 175 deg F (Minus 18 to 79 deg C).
   f. Compensate Temperature Limits: 30 to 150 deg F (Minus 1 to 66 deg C).
   g. Thermal Effects: 0.02 percent of full scale per degree F.
   h. Response Time: 30 to 50 ms.
   i. Shock and vibration shall not harm the transmitter.

2. Analog Output Current Signal:
   a. Two-wire, 4- to 20-mA dc current source.
   b. Signal capable of operating into 1000-ohm load.

3. Operator Interface:
   a. Zero and span adjustments located behind cover.
   b. Bleed screws on side of body, two screws on low-pressure side, and one screw on high-pressure side, for air in line and pressure cavity.

4. Construction:
   a. Aluminum and stainless-steel enclosure with removable cover.
   b. Wetted parts of transmitter constructed of 17-4 PH or 300 Series stainless steel.
   c. Threaded, NPS 1/4 (DN 10) process connections on side of instrument enclosure.
   d. Knock out for 1/2-inch (16-mm) nominal conduit connection on side of instrument enclosure.
   e. Screw terminal block for wire connections.
   f. NEMA 250, Type 4X.
   g. Mounting Bracket: Appropriate for installation.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.
B. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement, sway, or a break in attachment when subjected to a 50 lb force.

C. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.2 ELECTRICAL POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.3 PRESSURE INSTRUMENT INSTALLATION

A. Mounting Location:
   1. Rough-in: Outline instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
   2. Install switches and transmitters for liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
   3. Install liquid and steam pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

5. Install instruments (except pressure gages) in steam, liquid, and liquid-sealed piped services below their process connection point. Slope tubing down to instrument with a slope of 2 percent.

6. Install instruments in dry gas and noncondensable vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.

B. Liquid-Pressure Differential Switches:

1. Where process connections are located in mechanical equipment room, install switch in convenient and accessible location near system control panel.

2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate switch near system control panel.

3. Where multiple switches serving same system are installed in same room, install switches by system to provide service personnel a single and convenient location for inspection and service.

4. System process tubing connection shall be full size of switch connection, but not less than NPS ½. Install stainless-steel bushing if required to mate switch to system connection.

5. Connect process tubing from point of system connection and extend to switch.

6. Install isolation valves in process tubing as close to system connection as practical.

7. Install dirt leg and drain valve at each switch connection.

8. Do not mount switches on rotating equipment.

9. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.

10. Install switches in an easily accessible location serviceable from floor.

C. Liquid-Pressure Transmitters:

1. Where process connections are installed in mechanical equipment room, install transmitter in convenient and accessible location near system control panel.

2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate transmitter near system control panel.

3. Where multiple transmitters serving same system are installed in same room, install transmitters by system to provide service personnel a single and convenient location for inspection and service.

4. System process tubing connection shall be full size of switch connection, but not less than NPS ½. Install stainless-steel bushing if required to mate switch to system connection.

5. Connect process tubing from point of system connection and extend to transmitter.

6. Install isolation valves in process tubing as close to system connection as practical.

7. Install dirt leg and drain valve at each transmitter connection.

8. Do not mount transmitters on equipment.
9. Install in a location free from vibration, heat, moisture, or adverse effects, which could damage and hinder accurate operation.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 CHECKOUT PROCEDURES

A. Check out installed products before continuity tests, leak tests, and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate pressure instrument demonstration video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.23
SECTION 23 09 23.27 - TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Air temperature sensors.
   2. Air temperature switches.
   3. Air temperature RTD transmitters.
   4. Liquid and steam temperature sensors.

B. Related Requirements:
   1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:
1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:
   a. Outdoors, Protected: Type 3
   b. Outdoors, Unprotected: Type 4
   c. Indoors, Heated with Filtered Ventilation: Type 1
   d. Indoors, Heated with Non-Filtered Ventilation: Type 2
   e. Indoors, Heated and Air Conditioned: Type 1
   f. Mechanical Equipment Rooms:
      1) Chiller and Boiler Rooms: Type 12
      2) Air-Moving Equipment Rooms: Type 2
   g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2
   h. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4

2.2 AIR TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:
   1. 100 or 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
   2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
   3. Performance Characteristics:
      a. Range: Minus 50 to 275 deg F (Minus 46 to 135 deg C).
      b. Interchangeable Accuracy: At 32 deg F (zero deg C) within 0.5 deg F (0.3 deg C).
      c. Repeatability: Within 0.5 deg F (0.3 deg C).
   4. Transmitter Requirements:
      a. Transmitter required for each 100-ohm RTD.
      b. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.

B. Platinum RTD, Single-Point Air Temperature Duct Sensors:
   1. 1000 ohms.
   2. Temperature Range: Minus 50 to 275 deg F (Minus 45 to 135 deg C).
4. Length: As required by application to achieve tip at midpoint of air tunnel, up to 18 inches (450 mm) long.
5. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
6. Gasket for attachment to duct or equipment to seal penetration airtight.
7. Conduit Connection: 1/2-inch (16-mm) trade size.)

C. Platinum RTD, Air Temperature Averaging Sensors:
1. 1000 ohms.
2. Temperature Range: Minus 50 to 275 deg F (Minus 45 to 135 deg C).
3. Multiple sensors to provide average temperature across entire length of sensor.
4. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
5. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a 4-inch (100-mm) radius.
6. Length: As required by application to cover entire cross section of air tunnel.
7. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
8. Gasket for attachment to duct or equipment to seal penetration airtight.
9. Conduit Connection: 1/2-inch (16-mm) trade size.)

D. Platinum RTD Outdoor Air Temperature Sensors:
1. 1000 ohms.
2. Temperature Range: Minus 50 to 275 deg F (Minus 45 to 135 deg C).
5. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
6. Conduit Connection: 1/2-inch (16-mm) trade size.

E. Platinum RTD Space Air Temperature Sensors:
1. 1000 ohms.
2. Temperature Range: Minus 50 to 212 deg F (Minus 45 to 100 deg C).
3. Sensor assembly shall include a temperature sensing element mounted under a flush, brushed aluminum cover.
4. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
5. Concealed wiring connection.

F. Space Air Temperature Sensors for Use with DDC Controllers Controlling Terminal Units:
1. 1000-ohm platinum RTD.
2. Temperature Transmitter Requirements:
   a. Mating transmitter required with each 100-ohm RTD.
   b. Mating transmitters optional for 1000-ohm RTD and thermistor, contingent on compliance with end-to-end control accuracy.
3. Provide digital display of sensed temperature.
4. Provide sensor with local control.
   a. Local override to turn HVAC on.
   b. Local adjustment of temperature set point.
   c. Both features shall be capable of manual override through control system operator.

2.3 AIR TEMPERATURE SWITCHES

A. Thermostat and Switch for Low Temperature Control in Duct Applications:

1. Description:
   a. Two-position control.
   b. Field-adjustable set point.
   d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Performance:
   a. Operating Temperature Range: 15 to 55 deg F (Minus 9 to 13 deg C).
   b. Temperature Differential: 5 deg F (2.8 deg C), non-adjustable and additive.
   c. Enclosure Ambient Temperature: Minus 20 to 140 deg F (Minus 11 to 60 deg C).
   d. Sensing Element Maximum Temperature: 250 deg F (121 deg C).
   e. Voltage: 120-V ac.
   f. Current: 16 FLA.
   g. Switch Type: Two SPDT snap switches operate on coldest 12-inch (300-mm) section along element length.

3. Construction:
   a. Vapor-Filled Sensing Element: Nominal 20 feet (6 m) long.
   b. Dual Temperature Scale: Fahrenheit and Celsius visible on face.
   c. Set-Point Adjustment: Screw.
   d. Enclosure: Painted metal, NEMA 250, Type 1.
   e. Electrical Connections: Screw terminals.
   f. Conduit Connection: 1/2-inch (16-mm) trade size.

2.4 LIQUID AND STEAM TEMPERATURE SENSORS, COMMERCIAL GRADE

A. RTD:

1. Description:
   a. Platinum with a value of 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
   b. Encase RTD in a stainless-steel sheath with a 0.25-inch (6-mm) OD.
c. Sensor Length: 4, 6, or 8 inches (100, 150, or 200 mm) as required by application.
d. Process Connection: Threaded, NPS 1/2 (DN 15).
e. Two-stranded copper lead wires.
f. Powder-coated steel enclosure, NEMA 250, Type 4.
g. Conduit Connection: 1/2-inch (16-mm) trade size.)
h. Performance Characteristics:
   1) Range: Minus 40 to 210 deg F (Minus 40 to 99 deg C).
   2) Interchangeable Accuracy: Within 0.54 deg F (0.3 deg C) at 32 deg F (zero deg C).

B. Thermowells:
   1. Stem: Straight or stepped shank formed from solid bar stock.
   2. Material: Brass or stainless steel.
   5. Bore: Sized to accommodate sensor with tight tolerance between sensor and well.
   6. Furnish thermowells installed in insulated pipes and equipment with an extended neck.
   7. Length: 4, 6, or 8 inches (100, 150, or 200 mm) as required by application.
   8. Thermowells furnished with heat-transfer compound to eliminate air gap between wall of sensor and thermowell and to reduce time constant.

PART 3 - EXECUTION

3.1 TEMPERATURE INSTRUMENT APPLICATIONS

   A. Air Temperature Sensors:
      1. Duct, 1000-ohm platinum RTD.
      2. Outdoor, 1000-ohm platinum RTD
      3. Space, 1000-ohm platinum RTD.

   B. Liquid and Steam Temperature Sensors:
      1. Hydronic System, Liquid and steam temperature sensor, commercial grade

3.2 INSTALLATION, GENERAL

   A. Install products level, plumb, parallel, and perpendicular with building construction.

   B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 50 lb force.

   C. Fastening Hardware:
1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.
B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.4 TEMPERATURE INSTRUMENT INSTALLATIONS

A. Mounting Location:
1. Roughing In:
   a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
   b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
      1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
      2) Do not begin installation without submittal approval of mounting location.
   c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.
2. Install switches and transmitters for air and liquid temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
3. Install liquid and steam temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.

4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.

5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.

2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 72 inches (1.1 to 1.6 m) above the adjacent floor, grade, or service catwalk or platform.

   a. Make every effort to mount at 60 inches (1500 mm).

C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

D. Space Temperature Sensor Installation:

1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.

2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.

3. In finished areas, recess electrical box within wall.

4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.

5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.

E. Outdoor Air Temperature Sensor Installation:

1. Mount sensor in a discrete location facing north.

2. Protect installed sensor from solar radiation and other influences that could impact performance.

3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.

F. Single-Point Duct Temperature Sensor Installation:
1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed 24 inches (610 mm) in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

G. Averaging Duct Temperature Sensor Installation:
1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of 20 sq. ft. (1.86 sq. m) and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.
4. If required to have transmitter, mount transmitter in an accessible and serviceable location.

H. Low-Limit Air Temperature Switch Installation:
1. Install multiple low-limit switches to maintain coverage over entire cross-sectional area of air tunnel.
2. Fasten and support sensing element with manufacturer-furnished clips to keep element taut throughout entire length.
3. Mount switches outside of airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.
4. Install on entering side of cooling coil unless otherwise indicated on Drawings.

I. Liquid Temperature Sensor Installation:
1. Assembly shall include sensor, thermowell
2. For pipe NPS 4 (DN 100) and larger, install sensor and thermowell length to extend into pipe between 50 to 75 percent of pipe cross section.
3. For pipe smaller than NPS 4 (DN 100):
   a. Install reducers to increase pipe size to NPS 4 (DN 100) at point of thermowell installation.
   b. For pipe sizes NPS 2-1/2 and NPS 3 (DN 65 and DN 80), thermowell and sensor may be installed at pipe elbow or tee to achieve manufacturer-recommended immersion depth in lieu of increasing pipe size.
   c. Minimum insertion depth shall be 2-1/2 inches (65 mm).
4. Install matching thermowell.
5. Fill thermowell with heat-transfer fluid before inserting sensor.
6. Tip of spring-loaded sensors shall contact inside of thermowell.
7. For insulated piping, install thermowells with extension neck to extend beyond face of insulation.
8. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement. If top dead center location is not possible due to field constraints, install thermowell at location along top half of pipe.

3.5 IDENTIFICATION
A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.6 CLEANING
A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
B. Wash and shine glazing.
C. Polish glossy surfaces to a clean shine.

3.7 CHECK-OUT PROCEDURES
A. Check installed products before continuity tests, leak tests, and calibration.
B. Check temperature instruments for proper location and accessibility.
C. Verify sensing element type and proper material.
D. Verify location and length.
E. Verify that wiring is correct and secure.

3.8 FIELD QUALITY CONTROL
A. Perform the following tests and inspections:
   1. Perform according to manufacturer's written instruction.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
B. Prepare test and inspection reports.
3.9 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.

END OF SECTION 23 09 23.27
SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Steel pipe and fittings.
   2. Joining materials.
   3. Dielectric fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pipe and tube.
   2. Fittings.
   4. Transition fittings.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE


PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Hot-Water Heating Piping: 100 psig at 200 deg F.
   2. Air-Vent Piping: 200 deg F.
   3. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.
2.2 COPPER TUBE AND FITTINGS

A. Tube in "Drawn-Temper Copper Tube" Paragraph below is generally available in NPS 1/8 to NPS 12 (DN 6 to DN 300). Drawn-temper copper tube is commonly referred to as "hard" copper tube. Drawn-Temper Copper Tubing: ASTM B88, Type L.

B. Grooved, Mechanical-Joint, Copper Tube Appurtenances.
   1. Grooved-End Copper Fittings: ASTM B75, copper tube or ASTM B584, bronze casting.
   2. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting. EPDM-rubber gasket rated for minimum 230 deg F for use with ferrous housing, and steel bolts and nuts; 300 psig minimum CWP pressure rating.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Description:
      b. Pressure Rating: 125 psig minimum at 180 deg F.
      c. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

C. Makeup-water piping installed aboveground shall be the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
D. Condensate-Drain Piping, Copper: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to the following:
   1. Section 23 05 23.12 "Ball Valves for HVAC Piping."
   2. Section 23 05 23.14 "Check Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.

U. Install sleeves for piping penetrations of walls, ceilings, and floors.

V. Install sleeve seals for piping penetrations of concrete walls and slabs

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

F. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.4 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced code, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting and coupling

F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 19 "Meters and Gauges for HVAC Piping."
3.7 CHEMICAL TREATMENT

A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13
SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hydronic specialty valves.
   2. Air-control devices.
   3. Strainers.
   4. Connectors.

B. Related Requirements:
   1. Section 23 05 23.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
   2. Section 23 05 23.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
   3. Section 23 05 23.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
   4. Section 23 09 23.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product:
   1. Include construction details and material descriptions for hydronic piping specialties.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
B. Safety Valves and Pressure Vessels: Shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   2. Ball: Brass or stainless steel.
   3. Plug: Resin.
   4. Seat: PTFE.
   5. End Connections: Threaded or socket.
   7. Handle Style: Lever, with memory stop to retain set position.
   8. CWP Rating: Minimum 125 psig.
   9. Maximum Operating Temperature: 250 deg F.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:
   1. Body: Bronze.
   2. Internal Parts: Nonferrous.
   3. Operator: Screwdriver or thumbscrew.
   4. Inlet Connection: NPS 1/2.
   7. Maximum Operating Temperature: 225 deg F.

2.3 STRAINERS

A. Y-Pattern Strainers:
   1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: Stainless-steel, 40 mesh strainer, or perforated stainless-steel basket.

2.4 CONNECTORS

A. Stainless-Steel Bellow, Flexible Connectors:
2. End Connections: Threaded or flanged to match equipment connected.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
B. Install calibrated-orifice, balancing valves at each branch connection to return main.
C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

END OF SECTION 23 21 16
SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   4. Duct liner.
   5. Sealants and gaskets.
   6. Hangers and supports.

B. Related Sections:
   1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.

B. Delegated-Design Submittal:
   1. Sheet metal thicknesses.
   2. Joint and seam construction and sealing.
   3. Reinforcement details and spacing.
   4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
B. Welding certificates.
C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-
support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity:
      a. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
   2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

C. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
H. Trapeze and Riser Supports:

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.
   1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
   2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK
A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead.
C. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
D. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING
A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION
A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Cable Support.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:


2. Test the following systems:

   a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.

Test for leaks before applying external insulation.

Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

Give **seven** days' advance notice for testing.

**C. Duct System Cleanliness Tests:**

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

**D. Duct System will be considered defective if it does not pass tests and inspections.**

**E. Prepare test and inspection reports.**

**3.8 DUCT CLEANING**

**A. Clean new duct system(s) before testing, adjusting, and balancing.**

**B. For cleaning of existing ductwork, see Section 23 01 30.52 "Existing HVAC Air Distribution System Cleaning."**

**C. Use duct cleaning methodology as indicated in NADCA ACR.**

**D. Use service openings for entry and inspection.**

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

**E. Particulate Collection and Odor Control:**

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
F. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.9 STARTUP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Intermediate Reinforcement:

C. Liner:

1. Supply-Air Ducts: Fibrous glass, Type I or Flexible elastomeric 1-1/2 inches thick.
2. Return-Air Ducts: Fibrous glass, Type I or Flexible elastomeric 1-1/2 inches thick.
3. Transfer Ducts: Fibrous glass, Type I or Flexible elastomeric 1-1/2 inches thick.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Velocity 1000 fpm or Lower:
      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.
   b. Velocity 1000 to 1500 fpm:
      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
   c. Velocity 1500 fpm or Higher:
      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-
1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to-Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13
SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   2. Control dampers.
   3. Fire dampers.
   4. Flange connectors.
   5. Turning vanes.
   6. Duct-mounted access doors.
   7. Duct access panel assemblies.
   8. Flexible connectors.
   9. Duct accessory hardware.
   10. Exhaust Arm

B. Related Requirements:
   1. Section 23 33 46 "Flexible Ducts" for insulated and non-insulated flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      c. Control-damper installations.
      d. Fire-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors.
      e. Duct security bars.
1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A and NFPA 90B.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Performance:
   a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.

2. Construction:
   a. Linkage out of airstream.
   b. Suitable for horizontal or vertical airflow applications.

3. Frames:
   a. Hat-shaped, 16-gauge-thick, galvanized sheet steel.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
d. Galvanized steel; 16 gauge thick.

5. Blade Axles: Galvanized steel
6. Bearings:
   a. Molded synthetic
   b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

7. Tie Bars and Brackets: Galvanized steel.
8. Locking device to hold damper blades in a fixed position without vibration.

2.3 FIRE DAMPERS
A. Type: dynamic; rated and labeled in accordance with UL 555 by an NRTL.
B. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.
C. Fire Rating: 1-1/2 hours.
D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.
F. Mounting Orientation: Vertical or horizontal as indicated.
G. Blades: Roll-formed galvanized sheet steel Material gauge is to be in accordance with UL listing.
H. Heat-Responsive Device:
   1. Replaceable, 165 deg F rated, fusible links.

2.4 FLANGE CONNECTORS
A. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
B. Material: Galvanized steel.
C. Gauge and Shape: Match connecting ductwork.
2.5 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

D. Vane Construction:
   1. Double wall.

2.6 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."

   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. 24-gauge-thick galvanized steel door panel.
      d. Vision panel.
      e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
      f. Fabricate doors airtight and suitable for duct pressure class.

   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
      a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum frame.

   3. Number of Hinges and Locks:
      a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
      c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
      d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
2.7 FLEXIBLE CONNECTORS

A. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Materials: Flame-retardant or noncombustible fabrics.

D. Coatings and Adhesives: Comply with UL 181, Class 1.

E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

2.8 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.9 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.

2.10 Exhaust Arm

A. Swivel Joint: 360 degrees

B. Diameter: 6”
C. Wall Mounting Bracket

D. Internal Support

E. Accessories:
   1. Extraction Hood

2.11 Exhaust Hood

A. The hood(s) shall be constructed of a minimum of 18 gauge 400 series stainless steel (300 series optional). The hood(s) shall be constructed using the standing seam method for optimum strength and with a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight. Lighter material gauges, alternate material types and finishes are not acceptable.

B. Vapor proof, U.L. Listed LED light fixtures shall be pre-wired to a junction box situated at the top of the hood for field connection. Wiring shall conform to the requirements of the NFPA® 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

   1. Install steel volume dampers in steel ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.

F. Install fire dampers in accordance with UL listing.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-ft. spacing.
8. Upstream and downstream from turning vanes.
9. For grease ducts, install at locations and spacing as required by NFPA 96.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.

J. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate fire dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.

END OF SECTION 23 33 00
SECTION 23 33 46 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Insulated flexible ducts.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For flexible ducts.
   1. Include plans showing locations and mounting and attachment details.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

2.2 INSULATED FLEXIBLE DUCTS
A. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   3. Temperature Range: Minus 10 to plus 160 deg F.
   4. Insulation R-Value: Comply with ASHRAE/IES 90.1
2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

D. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with draw bands.

F. Install duct test holes where required for testing and balancing purposes.

G. Installation:
   1. Install ducts fully extended.
   2. Do not bend ducts across sharp corners.
   3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
   4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
   5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:
   1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
   2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
   3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer’s written installation instructions.
   4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 23 33 46
SECTION 23 34 13 - AXIAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
B. Seismic Qualification Data: Certificates, for fans, accessories, and components, from manufacturer.
C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.2 MIXED FLOW FANS

A. General:

1. Base fan performance at standard conditions (density 0.075 Lb. /ft³).
2. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.
3. Each fan shall be direct drive in AMCA arrangement 4 according to drawings.
4. Fans are to be equipped with lifting lugs.
5. After fabrication all non-galvanized carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector coating electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.
6. Fans shall be licensed to bear the AMCA ratings seal for air performance (AMCA 210) and sound performance (AMCA 300).
7. Each fan shall be given an electronic vibration analysis in accordance with ANSI/AMCA Standard 204, while operating at the specified fan RPM. The vibration signatures shall be taken on the motor mounting plate in the horizontal, vertical and axial direction. The maximum allowable fan horizontal axis vibration shall meet balance quality grade G 1.0 standards (0.0785 in. /sec peak velocity; filter-in, reading as measured at the fan RPM) This report shall be provided at no charge to the customer upon request.

B. Fan Housing and Outlet:

1. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
2. Tubular fan housing shall be completely welded and coated with a minimum of 2-4 mils of coating, electrostatically applied and baked. No uncoated metal fan parts will be allowed. Tubular fan housing shall be completely welded of galvanized steel. Weld seem shall be treated with zinc coating to prevent corrosion.
3. Housing shall be constructed of welded structural steel members to prevent vibration and rigidly support the impeller and motor.
4. All mixed flow housings shall include vanes to straighten airflow prior to exiting the fan discharge.
5. Units shall incorporate a universal mounting system that allows the fan to be mounted in either vertical or horizontal configurations and field rotation of the motor position in 90-degree increments.
6. An access door shall be supplied for impeller inspection and service.
7. Extended grease lubrication lines shall be provided from the motor bearings to the exterior of the fan housing.

C. Fan Impeller:

1. Fan impeller shall be mixed flow design. The impeller shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.
2. Fan impeller shall be manufactured with continuously welded steel airfoils and coated with a minimum of 2-4 mils of coating, electrostatically applied and baked.
3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

D. Fan Motors and Drive:

1. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 870, 1170 or 1770 in 60 Hz (950, 1440 in 50 Hz), Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor on line (sinewave) frequency. Motor shall be labeled for use with a VFD with 10:1 VT and 1.0 service factor. Internal shaft grounding ring shall be provided to protect the motor bearings from electrical damage.

2.3 SOURCE QUALITY CONTROL

A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.
D. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install axial fans level and plumb.
B. Disassemble and reassemble units, as required for moving to the final location, in accordance with manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:
   1. Support duct-mounted and other hanging axial fans directly from the building structure, using suitable hanging systems as specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
   2. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

E. Install units with adequate clearances for service and maintenance.

F. Label fans in accordance with requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."

B. Where installing ducts adjacent to fans, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
3.5 STARTUP SERVICE:

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.
B. Adjust belt tension.
C. Lubricate bearings.
D. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections
1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties.
3. Fans and components will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain axial HVAC fans.

END OF SECTION 23 34 13
SECTION 23 37 13.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Louver face diffusers.
   2. Linear slot diffusers.

B. Related Requirements:
   1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
   2. Section 23 37 13.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 LOUVER FACE DIFFUSERS

A. Material: Aluminum.

B. Finish: Baked enamel, color selected by Architect.

C. Face Size: See Schedule.

D. Mounting: See Schedule.

E. Pattern: See Schedule core style.

F. Dampers: Radial opposed blade.

G. Accessories:
   1. R-6 - Insulation blanket.
2.2 LINEAR SLOT DIFFUSERS

A. Material - Shell: Aluminum, insulated.
B. Material - Pattern Controller and Tees: Aluminum.
C. Finish - Face and Shell: Baked enamel, black.
D. Finish - Pattern Controller: Baked enamel, black.
E. Finish - Tees: **Baked enamel, color selected by Architect**
F. Slot Width: See Schedule.
G. Number of Slots: See Schedule.
H. Length: See Schedule.
I. Accessories: See Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers level and plumb.
B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.13
SECTION 23 37 13.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fixed face registers and grilles.

B. Related Requirements:
   1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
   2. Section 23 37 13.13 "Air Diffusers" for various types of air diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Fixed Face Register

1. Material: Aluminum.
2. Finish: Baked enamel, color selected by Architect.
8. Damper Type: See Schedule.

2.2 GRILLES

A. Fixed Face Grille

1. Material: Aluminum.
2. Finish: Baked enamel, color selected by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.23
SECTION 23 73 13.13 - INDOOR, BASIC AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes factory-assembled, indoor air-handling units with limited features, including the following components and accessories:

1. Casings.
2. Fans, drives, and motors.
3. Coils.
4. Air filtration.
5. Dampers.

1.2 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

B. Shop Drawings: For each type and configuration of indoor, basic, air-handling unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of indoor, basic air-handling units, as well as procedures and diagrams.
4. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Source quality-control reports.

C. Startup service reports.

D. Field quality-control reports.

E. Sample Warranty: For manufacturer's warranty.
1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of indoor, basic, air-handling units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturer's standard, but not less than one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Structural Performance: Casing panels shall be self-supporting and capable of withstanding positive/negative 4-inch wg of internal static pressure, without exceeding a midpoint deflection of 0.005 inches/inch of panel span.

2.2 UNIT CASINGS

A. General Fabrication Requirements for Casings;

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Joints: Sheet metal screws or pop rivets.
3. Sealing: Seal all joints with water-resistant sealant. Hermetically seal at each corner and around entire perimeter.
4. Base Rail:
   a. Material: Galvanized steel
   b. Height: 4 inches

B. Double-Wall Construction:
1. Outside Casing Wall: Galvanized steel, minimum 20 gauge thick, with manufacturer's standard finish.
2. Inside Casing Wall: G90 galvanized steel solid, minimum 20 gauge thick.
3. Floor Plate: G90 galvanized steel minimum 20 gauge thick.
4. Casing Insulation:
   b. Casing Panel R-Value: Minimum R-13
   c. Insulation Thickness: 2 inch
   d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. Static-Pressure Classifications:
1. For Unit Sections Upstream of Fans: Minus 3-inch wg
2. For Unit Sections Downstream and Including Fans: 3-inch wg

E. Panels and Doors:

1. Panels:
   a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
   b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow.
   c. Gasket: Neoprene, applied around entire perimeters of panel frames.
   d. Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 60 inches

2. Doors:
   a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
   b. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
   c. Gasket: Neoprene, applied around entire perimeters of frame.
   d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 60 inches

3. Locations and Applications:
   a. Fan Section: Doors
   b. Coil Section: Panels.
c. Access Section: Doors

d. Access Sections Immediately Upstream and Downstream of Coil Sections: Panels

e. Damper Section: Panels.

f. Filter Section: Doors large enough to allow periodic removal and installation of filters.

F. Condensate Drain Pans:

1. Location: Each type of cooling coil.
2. Construction:


3. Drain Connection:

   a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

   b. Minimum Connection Size: NPS 1

4. Slope: Minimum 0.125 in./ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers, and to direct water toward drain connection.

5. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1


7. Depth: A minimum of 2 inches deep.

2.3 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Fans: Centrifugal, galvanized steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

   a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

   a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

   a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.

5. Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.

6. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch

7. Shaft Lubrication Lines: Extended to a location outside the casing.


C. Drive, Direct: Factory-mounted, direct drive.

D. Motors:

   1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

2.4 COIL SECTION

A. General Requirements for Coil Section:

   1. Comply with AHRI 410.

   2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).

   3. Coils shall not act as structural component of unit.

B. Preheat Coils:

   1. Hot-Water Coils: Continuous circuit

      a. Piping Connections: Threaded same end of coil.

      b. Tube Material: Copper

      c. Fin Type: Plate.

      d. Fin Material: Aluminum

      e. Fin and Tube Joint: Mechanical bond

      f. Headers:

         1) Seamless copper tube with brazed joints, prime coated.

         2) Provide insulated cover to conceal exposed outside casings of headers.

      g. Frames: Channel frame, minimum 0.052-inch-thick galvanized steel.

      h. Coil Working-Pressure Ratings: 200 psig, 325 deg F
C. Cooling Coils:

1. Chilled-Water Coil: Continuous circuit
   a. Piping Connections: Threaded same end of coil.
   b. Tube Material: Copper
   c. Fin Type: Plate.
   d. Fin Material: Aluminum
   e. Fin and Tube Joint: Mechanical bond
   f. Headers:
      1) Seamless copper tube with brazed joints, prime coated.
      2) Provide insulated cover to conceal exposed outside casings of headers.
   g. Frames: Channel frame, minimum 0.052-inch-thick stainless steel.
   h. Working-Pressure Ratings: 200 psig, 325 deg F

2.5 AIR FILTRATION SECTION

A. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
4. Filter-Media Frame: High wet-strength beverage board with perforated metal retainer, or metal grid, on outlet side.

B. Adhesive, Sustainability Projects: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.

C. Side-Access Filter Mounting Frames:

1. Particulate Air Filter Frames: Match inner casing and outer casing material, and insulation thickness. Galvanized steel track.
   a. Sealing: Incorporate positive-sealing device to ensure seal between gasketed material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

2.6 DAMPERS

A. Dampers: Comply with requirements in Section 23 09 23.12 "Control Dampers."

B. Damper Operators: Comply with requirements in Section 23 09 23.12 "Control Dampers."
2.7 MATERIALS

A. Steel:
   1. ASTM A36/A36M for carbon structural steel.
   2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:
   1. Manufacturer's standard grade for casing.
   2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.


2.8 SOURCE QUALITY CONTROL

A. AHRI 430 Certification: Test, rate, and label air-handling units and their components in accordance with AHRI 430.

B. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label in accordance with AHRI 260 or AMCA 311.

C. Fan Aerodynamic Performance Rating: Factory test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency in accordance with AMCA 210.

D. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.

E. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

F. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.

G. Refrigerant Coils: Factory tested to minimum 450-psig internal pressure, and to minimum 300-psig internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

B. Equipment Mounting:
1. Install air-handling units on cast-in-place concrete equipment bases. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

E. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

3.2 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to air-handling unit, allow for service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4 ASTM B88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
3.4 CONTROL CONNECTIONS
   A. Install control and electrical power wiring to field-mounted control devices.
   B. Connect control wiring according to Section 26 05 23 "Control-Voltage Electrical Power Cables."

3.5 STARTUP SERVICE
   A. Perform startup service.
      1. Complete installation and startup checks according to manufacturer's written instructions.
      2. Verify that shipping, blocking, and bracing are removed.
      3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
      4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
      5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
      6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
      7. Comb coil fins for parallel orientation.
      8. Verify that proper thermal-overload protection is installed for electric coils.
     10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

   B. Starting procedures for air-handling units include the following:
      1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm
      2. Measure and record motor electrical values for voltage and amperage.
      3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING
   A. Adjust damper linkages for proper damper operation.
   B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING
   A. After completing system installation and testing, adjusting, and balancing of air-handling unit and air-distribution systems, and after completing startup service, clean air-handling units
internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Air-handling unit and components will be considered defective if unit or components do not pass tests and inspections.
5. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 13.13
SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ductless fan coil units and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.

C. Samples: For units with factory-applied color finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale and coordinated with each other based on input from installers of the items involved.

B. Field quality-control reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 DUCTLESS FAN COIL UNITS

A. Coil Section Insulation: 1-inch thick, matte-finish, closed-cell foam complying with ASTM C1071 and attached with adhesive complying with ASTM C916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84 by a qualified testing agency.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Coil Section Insulation: Insulate coil section according to Section 23 06 16 "HVAC Equipment Insulation."

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84 by a qualified testing agency.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Main and Auxiliary Drain Pans: Plastic. Fabricate pans and drain connections to comply with ASHRAE 62.1.

D. Chassis: Galvanized steel where exposed to moisture, with powder-coat finish and removable access panel.

E. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color as selected by Architect

1. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain.

2. Steel recessing flanges for recessing fan coil units into ceiling or wall.

F. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.

1. MERV Rating: 8 when tested according to ASHRAE 52.2.
G. Hydronic Coils: Copper tubing with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

H. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
   2. Motor: EC Motor
   3. Wiring Termination: Connect motor to chassis wiring with plug connection.

I. Factory, Hydronic Piping Package: ASTM B88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
   1. Two-way, modulating control valve for chilled-water coil.
   2. Three-way, modulating control valve for hot-water heating coil.
   3. Hose Kits: Minimum 400-psig working pressure and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
      a. Length: 24 inches.
      b. Minimum Diameter: Equal to fan coil unit connection size.
   4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
   5. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and a memory stop to retain set position.
   6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.

J. Control devices and operational sequences are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 23 09 93.11 "Sequence of Operations for HVAC DDC."

K. DDC Terminal Controller:
   1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
   2. Unoccupied-Period-Override Operation: Two hours.
   3. Unit Supply-Air Fan Operation:
      a. Occupied Periods: Fan runs continuously.
      b. Unoccupied Periods: Fan cycles to maintain room setback temperature.
   4. Hydronic-Cooling-Coil Operation:
a. Occupied Periods: Modulate control valve to maintain room temperature.
b. Unoccupied Periods: Close control valve.

5. Heating-Coil Operation:
   a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
   b. Unoccupied Periods: Start fan and modulate control valve if room temperature falls below setback temperature.

6. Controller shall have volatile-memory backup.

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install fan coil units level and plumb.
   B. Install fan coil units to comply with NFPA 90A.
   C. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 2305.48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
   D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.
   E. Install new filters in each fan coil unit within two weeks after Substantial Completion.
   F. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
      1. Install piping adjacent to machine to allow service and maintenance.
      2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
      3. Connect condensate drain to indirect waste.
         a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.
   G. Ground equipment according to Section 2605.26 "Grounding and Bonding for Electrical Systems."
   H. Connect wiring according to Section 2605.19 "Low-Voltage Electrical Power Conductors and Cables."
3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 23 82 19
SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Copper building wire rated 600 V or less.
      2. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE
   A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
   B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1. Alpha Wire Company.
      2. American Bare Conductor.
      3. Belden Inc.
      4. Cerro Wire LLC.
      5. Encore Wire Corporation.
      6. General Cable Technologies Corporation.
      7. Okonite Company (The).
      8. Service Wire Co.
     10. WESCO.

   C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:
   1. Type RHH and Type RHW-2: Comply with UL 44.
   2. Type USE-2 and Type SE: Comply with UL 854.
   3. Type THHN and Type THWN-2: Comply with UL 83.
   4. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
   5. Type XHHW-2: Comply with UL 44.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. 3M Electrical Products.
   2. AFC Cable Systems; a part of Atkore International.
   5. Ideal Industries, Inc.
   6. ILSCO.
   7. NSi Industries LLC.
   8. O-Z/Gedney; a brand of Emerson Industrial Automation.
   10. TE Connectivity Ltd.
   11. Thomas & Betts Corporation; A Member of the ABB Group.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
   1. Material: Copper.
   2. Type: One hole with standard barrels.
   3. Termination: Compression.
PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
C. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

END OF SECTION 26 05 19
SECTION 26 05 23 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backboards.
2. Category 5e balanced twisted pair cable.
3. Balanced twisted pair cabling hardware.
4. Low-voltage control cabling.
5. Control-circuit conductors.
6. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
   1. Flame Travel Distance: 60 inches or less.
   2. Peak Optical Smoke Density: 0.5 or less.
   3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

E. RoHS compliant.

2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 06 10 00 "Rough Carpentry."

B. Painting: Paint plywood on all sides and edges with flat latex paint. Comply with requirements in Section 09 91 23 "Interior Painting."

2.3 CATEGORY 5e BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AMP NETCONNECT; a TE Connectivity Ltd. company.
   2. Belden Inc.
   3. Berk-Tek Leviton; a Nexans/Leviton alliance.
   4. CommScope, Inc.
   5. General Cable; General Cable Corporation.
   6. Hitachi Cable America Inc.
   7. Mohawk; a division of Belden Networking, Inc.
   8. SYSTIMAX Solutions; a CommScope Inc. brand.
   9. West Penn Wire.

C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.

D. Conductors: 100-ohm, 24 AWG solid copper.

E. Shielding/Screening: Shielded twisted pairs (FTP).
F. Cable Rating: Plenum.

G. Jacket: White thermoplastic.

2.4 BALANCED TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
3. AMP NETCONNECT; a TE Connectivity Ltd. company.
4. Belden CDT Networking Division/NORDX.
5. Berk-Tek Leviton; a Nexans/Leviton alliance.
6. CommScope, Inc.
7. Draka USA.
8. Dynacom Corporation.
9. General Cable; General Cable Corporation.
10. Genesis Cable Products; Honeywell International, Inc.
11. Hubbell Premise Wiring.
12. KRONE Incorporated.
13. Leviton Manufacturing Co., Inc.
14. Mohawk; a division of Belden Networking, Inc.
15. Molex Premise Networks.
16. Panduit Corp.
17. Siemon Co. (The).
18. Superior Essex Inc.
19. SYSTIMAX Solutions; a CommScope Inc. brand.

C. General Requirements for Balanced Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 5e.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain balanced twisted pair cable hardware from same manufacturer as balanced twisted pair cable, from single source.

E. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.

G. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:
   
   a. Universal T568A and T568B wiring labels.
   b. Labeling areas adjacent to conductors.
   c. Replaceable connectors.
   d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.

3. Number of Jacks per Field: One for each four-pair cable indicated.

H. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

I. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.

2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.

3. Marked to indicate transmission performance.

J. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.

2. Designed to snap-in to a patch panel or faceplate.

3. Standards:
   
   a. Category 5e, shielded balanced twisted pair cable shall comply with IEC 60603-7-3.

4. Marked to indicate transmission performance.

K. Faceplate:

1. Two port, vertical single-gang faceplates designed to mount to single-gang wall boxes.

3. Metal Faceplate: Stainless steel, complying with requirements in Section 26 27 26 "Wiring Devices."
4. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.
   a. Flush mounting jacks, positioning the cord at a 45-degree angle.

L. Legend:
   1. Machine printed, in the field, using adhesive-tape label.
   2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 RS-232 CABLE

A. PVC-Jacketed, TIA 232-F:
   1. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. Polypropylene insulation.
   3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
   4. PVC jacket.
   5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
   6. NFPA 70 Type: Type CM.
   7. Flame Resistance: Comply with UL 1581.

B. Plenum-Type, TIA 232-F:
   1. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. PE insulation.
   3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
   4. Fluorinated ethylene propylene jacket.
   5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

2.6 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.7 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Encore Wire Corporation.
2. General Cable; General Cable Corporation.
3. Service Wire Co.

B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.8 SOURCE QUALITY CONTROL

A. Factory test twisted pair cables according to TIA-568-C.2.

B. Cable will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.
3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
2. Outlet boxes for cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
3. Flexible metal conduit shall not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Secure conduits to backboard if entering the room from overhead.
3. Extend conduits 3 inches above finished floor.
4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.


11. Support: Do not allow cables to lie on removable ceiling tiles.

12. Secure: Fasten securely in place with hardware specifically designed and installed so as not to damage cables.

13. Provide strain relief.

14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.

15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:


2. Install termination hardware as specified in Section 27 15 13 "Communications Copper Horizontal Cabling" unless otherwise indicated.

3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.

2. Use insulated spade lugs for wire and cable connection to screw terminals.

3. Comply with requirements specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.

3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
   1. Class 1 remote-control and signal circuits; No 14 AWG.
   2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
B. Comply with TIA-569-D, Annex A, "Firestopping."
C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
B. For low-voltage control wiring and cabling, comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.
C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Tests and Inspections:
   1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
   2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
      a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 26 05 23
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS
A. Qualification Data: For testing agency and testing agency's field supervisor.

1.4 QUALITY ASSURANCE
A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.
B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO; a brand of nVent.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. ILSCO.
7. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Thomas & Betts Corporation; A Member of the ABB Group.
2.3 **CONDUCTORS**

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 **CONNECTORS**

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Conduit Hubs: Mechanical type, terminal with threaded hub.

G. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

H. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

I. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

J. Straps: Solid copper, copper lugs. Rated for 600 A.

K. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.
PART 3 - EXECUTION

3.1 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.2 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
   3. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26
SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Allied Tube & Conduit; a part of Atkore International.
   b. B-line, an Eaton business.
   c. CADDY; a brand of nVent.
   d. Flex-Strut Inc.
   e. Gripple Inc.
   f. GS Metals Corp.
   g. G-Strut.
   h. Haydon Corporation.
   i. Metal Ties Innovation.
   j. MIRO Industries.
   k. Thomas & Betts Corporation; A Member of the ABB Group.
   l. Unistrut; Part of Atkore International.
   m. Wesanco, Inc.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) B-line, an Eaton business.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti, Inc.
4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
5. Toggle Bolts: All-steel springhead type.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION 26 05 29
SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal conduits and fittings.
   2. Nonmetallic conduits and fittings.
   3. Surface raceways.

B. Related Requirements:
   1. Section 07 84 13 "Penetration Firestopping" for firestopping at conduit and box entrances.
   2. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, boxes, enclosures, and cabinets serving communications systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
   1. Structural members in paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AFC Cable Systems; a part of Atkore International.
   b. Allied Tube & Conduit; a part of Atkore International.
   c. Anamet Electrical, Inc.
   d. Calconduit.
   e. Electri-Flex Company.
   f. FSR Inc.
   g. Korkap.
   h. NEC, Inc.
   i. Opti-Com Manufacturing Network, Inc (OMNI).
   j. O-Z/Gedney; a brand of Emerson Industrial Automation.
   k. Perma-Cote.
   l. Picoma Industries, Inc.
   m. Plasti-Bond.
   n. Republic Conduit.
   o. Southwire Company.
   p. Thomas & Betts Corporation; A Member of the ABB Group.
   q. Topaz Electric; a division of Topaz Lighting Corp.
   r. Western Tube and Conduit Corporation.
   s. Wheatland Tube Company.

2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with ANSI C80.1 and UL 6.

4. ARC: Comply with ANSI C80.5 and UL 6A.

5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   a. Comply with NEMA RN 1.
   b. Coating Thickness: 0.040 inch, minimum.

6. EMT: Comply with ANSI C80.3 and UL 797.

7. FMC: Comply with UL 1; zinc-coated steel.

8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AFC Cable Systems; a part of Atkore International.
   b. Allied Tube & Conduit; a part of Atkore International.
   c. Anamet Electrical, Inc.
   d. Calconduit.
   e. Electri-Flex Company.
   f. FSR Inc.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Fittings, General: Listed and labeled for type of conduit, location, and use.


5. Fittings for EMT:
   a. Material: Steel.
   b. Type: Compression.

6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for GRC or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AFC Cable Systems; a part of Atkore International.
   b. Anamet Electrical, Inc.
   c. Arno Corporation.
   d. CANTEX INC.
   e. CertainTeed Corporation.
f. Champion Fiberglass, Inc.
g. Condux International, Inc.
h. Electri-Flex Company.
i. FRE Composites.
j. Kraloy.
k. Lamson & Sessions.
l. Niedax Inc.
m. RACO; Hubbell.
n. Thomas & Betts Corporation; A Member of the ABB Group.
o. Topaz Electric; a division of Topaz Lighting Corp.
p. United Fiberglass.

B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. ENT: Comply with NEMA TC 13 and UL 1653.
2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
3. LFNC: Comply with UL 1660.

C. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFC Cable Systems; a part of Atkore International.
b. Anamet Electrical, Inc.
c. Arnco Corporation.
d. CANTEX INC.
e. CertainTeed Corporation.
f. Champion Fiberglass, Inc.
g. Condux International, Inc.
h. Electri-Flex Company.
i. FRE Composites.
j. Kraloy.
k. Lamson & Sessions.
l. Niedax Inc.
m. RACO; Hubbell.
n. Thomas & Betts Corporation; A Member of the ABB Group.
o. Topaz Electric; a division of Topaz Lighting Corp.
p. United Fiberglass.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
4. Fittings for LFNC: Comply with UL 514B.
5. Solvents and Adhesives: As recommended by conduit manufacturer.
2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Adalet.
3. EGS/Appleton Electric.
5. FSR Inc.
6. Hoffman; a brand of nVent.
8. Hubbell Incorporated; Wiring Device-Kellems.
10. Milbank Manufacturing Co.
11. MonoSystems, Inc.
12. Oldcastle Enclosure Solutions.
15. RACO; Hubbell.
16. Spring City Electrical Manufacturing Company.
17. Thomas & Betts Corporation; A Member of the ABB Group.
18. Topaz Electric; a division of Topaz Lighting Corp.
19. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

K. Gangable boxes are allowed.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:
   1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: GRC.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
      a. Mechanical rooms.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.


4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

Support conduit within 12 inches of enclosures to which attached.

Stub-ups to Above Recessed Ceilings:
1. Use EMT or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Conduit extending from interior to exterior of building.
2. Conduit extending into pressurized duct and equipment.
3. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
4. Where otherwise required by NFPA 70.

U. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   b. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33
SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
4. Tapes and stencils.
5. Signs.
6. Cable ties.
7. Paint for identification.
8. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS


B. Comply with NFPA 70.


D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E requirements for arc-flash warning labels.
F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
   1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
   5. Colors for Isolated Grounds: Green two or more yellow stripes.

C. Warning Label Colors:
   1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

E. Equipment Identification Labels:
   1. Black letters on a white field.

2.3 LABELS

A. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. A'n D Cable Products.
   b. Brady Corporation.
   c. Brother International Corporation.
   d. emedco.
   e. Grafoplast Wire Markers.
   f. Ideal Industries, Inc.
   g. LEM Products Inc.
   h. Marking Services, Inc.
   i. Panduit Corp.
   j. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. A'n D Cable Products.
   b. Brady Corporation.
   c. Brother International Corporation.
   d. emedco.
   e. Grafoplast Wire Markers.
   f. HellermannTyton.
   g. Ideal Industries, Inc.
   h. LEM Products Inc.
   i. Marking Services, Inc.
   j. Panduit Corp.
   k. Seton Identification Products.

2. Minimum Nominal Size:
   a. 1-1/2 by 6 inches for raceway and conductors.
   b. 3-1/2 by 5 inches for equipment.
   c. As required by authorities having jurisdiction.
2.4 BANDS AND TUBES

A. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Brady Corporation.
   b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Carlton Industries, LP.
   b. Champion America.
   c. HellermannTyton.
   d. Ideal Industries, Inc.
   e. Marking Services, Inc.
   f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. edeco.
   d. Marking Services, Inc.

C. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Carlton Industries, LP.
   b. Seton Identification Products.
2.6 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
   a. Carlton Industries, LP.
   b. Champion America.
   c. emedco.
   d. Marking Services, Inc.

2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.

3. 1/4-inch grommets in corners for mounting.


B. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. emedco.
   d. Marking Services, Inc.

2. Engraved legend.

3. Thickness:

   a. For signs up to 20 sq. in., minimum 1/16 inch thick.
   b. For signs larger than 20 sq. in., 1/8 inch thick.
   c. Engraved legend with black letters on white face.
   d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.
B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
   2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.
D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.


K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

L. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

M. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "POWER."

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

P. Self-Adhesive Labels:
   1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

T. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

U. Baked-Enamel Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

V. Laminated Acrylic or Melamine Plastic Signs:
   1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

W. Cable Ties: General purpose, for attaching tags, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

H. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

I. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
   a. Controls with external control power connections.


M. Operating Instruction Signs: Baked-enamel warning signs.

N. Emergency Operating Instruction Signs: Baked-enamel warning signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
O. Equipment Identification Labels:

1. Indoor Equipment: Baked-enamel signs.

END OF SECTION 26 05 53
PART 1 – GENERAL

1.01 The Functional Performance Testing of the Lighting and Electrical Systems is essential to the operation and performance of the equipment and the completion of the project. Complete all inspections and tests prior to substantial completion of the Work.

PART 2 – PRODUCTS

2.01 The following are suggested testing instruments that could be used but similar types of instruments are acceptable. If the Designer determines that additional instruments are required, provide at no additional charge.

A. Recommended Instruments for Testing Purposes
   1. Fluke 43B Single Phase Power Quality Analyzer: With Current Clamp and Voltage Probes
   2. EXTECH Instruments: Foot Candle/Lux Light Meter 401025
   3. Ideal 61-165 ARCFAULT 165
   4. Fluke 1AC-II / 1LAC-II VoltAlert
   5. Power Line Disturbance Monitor
   6. Load Profiler

PART 3 – EXECUTION

3.01 The Functional Performance Testing Procedures approved by the Designer will be used to document the inspection and testing of the equipment and systems. Provide all necessary manpower and have the appropriate subcontractor and/or manufacturer's representative present during the testing and demonstrate, to the Designers satisfaction, the full operation of all electrical and lighting systems. Coordinate the schedule of the testing so that the Designer and Owner can be present.

A. Prior to starting the final testing of the systems, ensure that all equipment and systems were initially started-up and initialized as prescribed by the manufacturer's instructions or by the manufacturer's representative and that the Contractor has performed a complete inspection and test of all electrical and lighting equipment and systems.

B. Review the Designer's inspection reports and correct all deficiencies.

C. Open and inspect all panels for cleanliness and neatness.

D. Check and record voltage and current readings on the Panel board Check Sheet (see Division 26 08).

E. Voltage and Amperage readings off by 5% between phases needs to be investigated and a variance of 10% indicated there is a problem.

F. Check the Ground for leakage current. Ground current of less than 1 amp is OK, 1 to 3 amps needs to be checked and more than 3 amps is a problem.
G. Main breaker settings, Long Term, Short Term, Instantaneous and Ground Fault, need to be checked, recorded and have the Electrical Designer verify they are correct.

NOTE: VFD’s will cause noise on neutral and ground and fluctuations on voltage as SCR’s fire. They also induce motor bearing currents and shaft voltages that will cause pitting of the shaft and motor failure. If none of the following shaft voltage/current eliminators are utilized on the motors, the motors should be checked for excessive voltage/current to determine if a retrofit is required.

H. Test receptacle circuits for voltage drop, impedance on hot leg and GFI/ARC, at the last receptacle on the branch line. Circuits used for computers or voltage sensitive equipment, at design amperage, must not be less than 6% and for all other circuits less than 10% of design. At all times the load voltage should not drop below 111 volts. Record findings on the Power Circuit Check Sheet (see Division 26 08).

I. Demonstrate the Lighting Control System utilizing the Performance Testing Identification Form and Performance Testing Procedures Form (see Division 01 91) approved by the Designer.

J. Demonstrate lighting levels at desk level after dark to ensure that they are not affected by outside light and record readings on the Lighting Check Sheet (see Division 26 08).

K. Perform power outage test and/or emergency generator test, under load, and utilize the procedure and record findings on the Emergency Generator Testing Procedures (see Division 26 08).

L. Check fuses and overloads in all motor starters.

M. Upon completion of the performance testing procedures, the Installer, General Contractor and Designers representatives who observed the testing will sign the Functional Performance Test Certification form (see Division 01 91) and attach deficiency list.

1. Emergency Power/Generator System
2. Electrical Switchgear/Panel boards
3. Electrical Power Circuits
4. Electrical Lighting

N. Provide testing instruments, at no charge or the Designer may elect to provide their own instruments.

END OF SECTION
<table>
<thead>
<tr>
<th>ITEM</th>
<th>PANEL</th>
<th>PANEL</th>
<th>PANEL</th>
<th>PANEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room sprinkler</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipes above panel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room air conditioned</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC code space</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduits secured</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire caulking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground buss</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCB/MLO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kAIC rating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel Manufacturer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel model number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel circuits ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wire colors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One wire per breaker</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wires neatly terminated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spare breakers off</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel clean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Measurements**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PANEL</th>
<th>PANEL</th>
<th>PANEL</th>
<th>PANEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>A amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-N volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-N volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-N volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-B volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-C volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-C volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-G volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# 26 08 13 - POWER CIRCUIT CHECK SHEET

**SBC Project No:**

**Institution or Campus:**

**Building:**

**Installer:**

**Page**

**Date:**

**Tests run by:**

**System/Unit Identifier:**

**Location:**

<table>
<thead>
<tr>
<th>Floor</th>
<th>Room</th>
<th>Panel</th>
<th>Ckt.</th>
<th>Device</th>
<th>Volts</th>
<th>Wiring</th>
<th>GFI/ARC msec/mA</th>
<th>V-Drop @ Load %</th>
<th>Imp/ohms Hot Leg</th>
<th>Coments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TN Higher Education - Standard Document - May 2018
<table>
<thead>
<tr>
<th>Floor</th>
<th>Room</th>
<th>Panel</th>
<th>Ckt.</th>
<th>Fixture Type</th>
<th>FC Level</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Indoor occupancy sensors.

B. Related Requirements:
   1. Section 26 27 26 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Show installation details for the following:
      a. Occupancy sensors.
   2. Interconnection diagrams showing field-installed wiring.
   3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.
1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Manufacturing Co., Inc.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.
5. Lutron Electronics Co., Inc.
6. Philips Lighting Controls.
7. Sensor Switch, Inc.
8. WattStopper; a Legrand® Group brand.

B. General Requirements for Sensors:

2. Dual technology.
3. Integrated power pack.
4. Hardwired connection to switch and BAS.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:

   a. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Sensor is powered from the power pack.
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, using hardwired connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V, and 800-W incandescent.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 2605 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 2605 19 "Low-Voltage Electrical Power Conductors and Cables."
C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."

B. Label time switches and contactors with a unique designation.
3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Final Acceptance, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Final Acceptance, service agreement shall include software support for two years.

B. Upgrade Service: At Final Acceptance, update software to latest version. Install and program software upgrades that become available within two years from date of Final Acceptance. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23
SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Distribution panelboards.
      2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS
   A. MCCB: Molded-case circuit breaker.
   B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of panelboard.
   B. Shop Drawings: For each panelboard and related equipment.
      1. Include dimensioned plans, elevations, sections, and details.
      2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
      3. Detail bus configuration, current, and voltage ratings.
      4. Short-circuit current rating of panelboards and overcurrent protective devices.
      5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
      6. Include wiring diagrams for power, signal, and control wiring.
      7. Key interlock scheme drawing and sequence of operations.
      8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS
   A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.
1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
   1. Panelboard Warranty Period: 18 months from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Surface-mounted, dead-front cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   2. Height: 84 inches maximum.
   3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

E. Incoming Mains Location: Convertible between top and bottom.

F. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

G. Conductor Connectors: Suitable for use with conductor material and sizes.
   2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
   3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
   4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

H. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. ESL Power Systems, Inc.
4. Mersen USA.
6. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker.


2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: As indicated on the drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
4. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.


3. Electronic Trip Circuit Breakers:
   a. RMS sensing.
   b. Field-replaceable rating plug or electronic trip.
   c. Digital display of settings, trip targets, and indicated metering displays.
   d. Multi-button keypad to access programmable functions and monitored data.
   e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
   f. Integral test jack for connection to portable test set or laptop computer.
   g. Field-Adjustable Settings:
      1) Instantaneous trip.
      2) Long- and short-time pickup levels.
      3) Long and short time adjustments.
      4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
9. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
   f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   g. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 26-09-13 "Electrical Power Monitoring and Control."
   h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
   i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 26-28-13 "Fuses."

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
2.7 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NEMA PB 1.1.

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box.

E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

   1. Set field-adjustable, circuit-breaker trip ranges.

G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16
SECTION 26 27 26 - WIRING DEVICES

PART 1 - _GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Standard-grade receptacles, 125 V, 20 A.
   2. GFCI receptacles, 125 V, 20 A.
   3. Wall plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Device Color:
   1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

F. Wall Plate Color: For plastic covers, match device color.
G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Standards: Comply with UL 498 and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Hubbell Incorporated; Wiring Device-Kellems.
b. Pass & Seymour/Legrand (Pass & Seymour).

d. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Type: Non-feed through.

5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.


C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.

3. Configuration: NEMA WD 6, Configuration 5-15R.

4. Type: Non-feed through.

5. Standards: Comply with UL 498 and UL 943 Class A.

6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

   1. Plate-Securing Screws: Metal with head color to match plate finish.
   4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
   1. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   2. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   3. Install wiring devices after all wall preparation, including painting, is complete.

C. Device Installation:
   1. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
   2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Verify that dimmers used for fan-speed control are listed for that application.
   3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 26
SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

   a. Control circuits.
   b. Motor-control centers.
   c. Panelboards.
   d. Switchboards.
   e. Enclosed controllers.
   f. Enclosed switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.
4. Mersen USA.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC.
2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC.
3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.
4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC.
7. Type T: 600-V, zero- to 800-A rating, 200 kAIC, very fast acting.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Construction Manager.

3.2 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13
SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers (MCCBs).
   5. Enclosures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

   1. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB Inc.
2. Eaton.
5. Square D; by Schneider Electric.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company.
3. NOARK Electric North America.
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

5. Square D; by Schneider Electric.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 140 deg F (60 deg C) rated wire on 125-A circuit breakers and below.

G. Standards: Comply with UL 489 with interrupting capacity to comply with available fault currents.


I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Long- and short-time pickup levels.
   2. Long- and short-time time adjustments.
   3. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   3. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
   4. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electro deposited on cleaned, phosphatized steel (NEMA 250 Type 1).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.2 INSTALLATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's written permission.
4. Comply with NFPA 70E.

B. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

D. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Install fuses in fusible devices.

G. Comply with NFPA 70 and NECA 1.

H. Set field-adjustable circuit-breaker trip ranges to values indicated on the Drawings.

3.3 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:
   a. Inspect physical and mechanical condition.
   b. Inspect anchorage, alignment, grounding, and clearances.
   c. Verify that the unit is clean.
   d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
   e. Verify that fuse sizes and types match the Specifications and Drawings.
   f. Verify that each fuse has adequate mechanical support and contact integrity.
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

   a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.
   a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
   a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

2. Electrical Tests:

   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
   e. Determine the following by primary current injection:

      1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.

g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.

h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 28 16
SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.3 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.
B. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS
A. Maintenance data.

1.5 WARRANTY
A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Ten years from date of Final Acceptance.
PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB Electrification Products Industrial Solutions.
3. ALLTEC.
4. Citel, Inc.
5. Eaton.
7. Liebert; a brand of Vertiv.
8. Mersen USA.
9. Schneider Electric USA, Inc.
11. SSI, an ILSCO Company.

B. SPDs: Comply with UL 1449, Type 1.

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 700 V for 208Y/120 V.
3. Neutral to Ground: 700 V for 208Y/120 V.
4. Line to Line: 1200 V for 208Y/120 V
2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Complete startup checks according to manufacturer's written instructions. Energize SPDs after power system has been energized, stabilized, and tested.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

   1. Compare equipment nameplate data for compliance with Drawings and Specifications.
   2. Inspect anchorage, alignment, grounding, and clearances.
   3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.
1.1 SUMMARY
A. See drawings for fixture manufacturers and fixture requirements.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

1.3 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Product Certificates: For each type of luminaire.

C. Product test reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.
1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

B. Altitude: Sea level to 1000 feet.

C. Electrical:

1. Power Factor: $\geq 0.90$ (at full luminaire output and across specified voltage range).
2. Total Harmonic Distortion: $\leq 20\%$ (at full luminaire output and across specified voltage range).
3. Transient and Surge Protection: ANSI C62.41 Category A surge protection standards up to and including 2.5 kV for interior fixtures.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

2.3 MANUFACTURERS

A. Manufacturers: See drawings for fixture manufacturers and fixture requirements.

2.4 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Steel:
   1. ASTM A36/A36M for carbon structural steel.
   2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:
   1. 1. Manufacturer's standard grade.
   2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Comply with NECA 1.
B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
C. Install lamps in each luminaire.
D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
E. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.2 IDENTIFICATION
A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL
A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
B. Luminaire will be considered defective if it does not pass operation tests and inspections.
C. Prepare test and inspection reports.

END OF SECTION 26 51 19
SECTION 26 52 13 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Emergency lighting units.
   2. Exit signs.
   3. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color Rendering Index.
C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
D. Fixture: See "Luminaire" Paragraph.
E. Lumen: Measured output of lamp and luminaire, or both.
F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.
B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:
B. Product Certificates: For each type of luminaire.
C. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.

1.6 WARRANTY
A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five year(s) from date of Final Acceptance.
B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
C. Comply with NFPA 70 and NFPA 101.
D. Comply with NEMA LE 4 for recessed luminaires.
E. Comply with UL 1598 for recessed luminaires.
F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.
   1. Emergency Connection: Operate all lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
   2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery
when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
   b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
   c. Humidity: More than 95 percent (condensing).
   d. Altitude: Exceeding 3300 feet.

4. Test Push-Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
   a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

5. Battery: Sealed, maintenance-free, nickel-cadmium type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is announced by an integral audible alarm and a flashing red LED.

G. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Emergency Connection: Operate one LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Nightlight Connection: Operate lamp in a remote fixture continuously.
5. Charger: Fully automatic, solid-state, constant-current type.
6. Housing: NEMA 250, Type I enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the ballast manufacturer, whichever is less.
7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
2. Emergency Luminaires: As indicated on Drawings.

C. Emergency Lighting Unit:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
2. Emergency Lighting Unit: As indicated on Drawings.

2.4 EXIT SIGNS

A. Internally Lighted Signs:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.5 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:
   1. Extruded aluminum housing and heat sink.

2.6 METAL FINISHES

A. 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.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire and emergency power unit weight.
   2. Able to maintain luminaire position when testing emergency power unit.
   3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.

E. Wall-Mounted Luminaire Support:
   1. Attached to a minimum 20-gage backing plate attached to wall structural members.
   2. Do not attach fixtures directly to gypsum board.

F. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of fixture chassis, including one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.

H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 26 52 13
SECTION 27 00 00 – GENERAL COMMUNICATIONS

PART 1 - GENERAL

1.1 OTHER CONDITIONS

A. Applicable provisions of the General conditions, Supplementary Conditions, and Division 1, General Requirements, apply to the Work under this Section.

1.2 RELATED WORK

A. Division 21: Fire Suppression, Division 22: Plumbing; Division 23: Mechanical; Division 26: Electrical.

B. See drawings and other sections for equipment requiring electrical service.

C. Painting (except factory-applied finishes on equipment) is specified elsewhere.

1.3 REFERENCE CODES AND STANDARDS

A. Make entire electrical installation in strict accordance with the requirements of all city, county, state, or federal codes of law having jurisdiction, the requirements and recommendations of the Board of Fire Underwriters, including all amendments and/or additions to said codes, laws, requirements and recommendations and the requirements and recommendations of the Power Company. Applicable codes are as follows:

2. NFPA 2
3. NFPA 70
4. NFPA 90A
5. NFPA 92A
6. NFPA 13
7. NFPA 13R
8. NFPA 13D
9. NFPA 14
10. International Building Code
11. International Fire Code
12. International Mechanical Code
13. NFPA 20

B. Refer to individual specification sections for additional standards covering the work set forth in these specifications.

C. Should any work shown on the drawings or herein specified be construed as being contrary to or not conforming to the previously mentioned Codes and Standards, bring it to the attention of the Architect before executing the work in conformity with the various codes, etc., without
additional cost to the Owner, but not until the matter in question has been reviewed by the Architect.

D. Should any work shown on the drawings or herein specified be more rigid as to requirements than the requirements of the various codes, the drawings and specifications shall be used in executing the work.

E. File with proper authorities all necessary drawings as required by various codes, laws, ordinances, or other requirements.

F. Obtain and pay for all permits and for all required inspection certificates. Pay necessary fees.

1.4 WARRANTY-GUARANTEE

A. WARRANT and guarantee that all work executed under this section of the specifications will be free from defects of materials and workmanship for a period of one year from the date of final acceptance of the building. The above parties further agree that they will, at their own expense, repair and replace all such defective work and all other work damaged thereby which is defective during the term of the warranty-guarantee.

1.5 ARCHITECTURAL DRAWINGS

A. Refer to architectural drawings for details such as finishes, dimensions, materials, etc. Refer to drawings for door locations, door swings, partitions location, cabinet and counters, making proper allowances, therefore. Refer to equipment plans for exact location of electrical connections which are dimensioned.

PART 2 - PRODUCTS

2.1 SUBMITTALS

A. Submit copies of manufacturer’s specifications, descriptions, illustrations, and installation instructions for each type of manufactured product to include: Outside plant and structured cabling intended for use on this project. The submittal shall consist of one or more brochures each containing only “one” copy of material describing the product. Several products may be included in each brochure.

B. Include manufacturer’s certification as may be required to show compliance with these specifications. Indicate by transmittal form that a copy of each instruction has been distributed to the installer.

C. Provide complete sets of operating and maintenance instructions applying to equipment installed in conjunction with this contract; include parts lists, wiring diagrams, catalog data, stamped approval submittal data, and operational checkout data as called for in these specifications, bound in hardback binders. Instructions shall be submitted to the Architect for approval at least one month in advance of initial start-up.
D. Refer to individual specification sections for additional submittal requirements covering the work set forth in these specifications.

2.2 PRODUCTS

A. Materials shall not be ordered until architect’s review of submittal material has been made. They shall be new and unused and the manufacturer’s standard product and the latest designs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The drawings which show the work included are diagrammatic only; the locations, routing, etc., of the various fixtures, items of equipment, wiring, etc., are approximate only. The entire installation is subject to such deviations, modifications, rerouting, etc., as may be necessary to meet the requirements of the architectural, structural, and other drawings; and also as necessary to obtain a proper coordination of the work with that of all other trades.

B. Carefully check and become familiar with the above-mentioned drawings, and frequently consult with all other trades so that the work may proceed as a harmonious whole.

C. Install concealed all wiring except where the Architect grants specified permission to run same exposed.

D. Installer shall defer the installation of all electrical fixtures liable to damage. After fixtures are permanently installed, completely protect against breaking, damage, or the depositing of any waste material herein until the system is accepted.

3.2 COORDINATION

A. Carefully check locations, layouts, and dimensions of all items to be installed under this section with the above-mentioned drawings, and coordinate with all trades affected.

B. Any work installed without properly checking and coordinating same as above provided, which as a result interferes with the proper installation of the work of other trades, is to be removed and properly reinstalled at contractor’s expense.

C. It is the installer’s responsibility to notify well in advance, all trades affected, or any chases, recesses, etc., which may be required for the installation of the work. Should this be neglected, any cutting and/or patching required for such chases, recesses, etc., to be done at this contractor’s expense.
3.3 PROTECTION AND CLEANING

A. Protect work, equipment, and materials at all times. Tightly cover and protect equipment against dirt, water, chemical, or mechanical injury. At final completion of all work to be thoroughly cleaned and delivered in a perfect unblemished condition.

B. Touch-up all damaged paint surfaces on equipment to match original paint.

3.4 INITIAL OPERATION OF EQUIPMENT

A. Give all equipment furnished in the contract an operational test prior to final acceptance. Assist the Owner in the initial operation when the owner operates the building and equipment. Instruct the owner’s personnel in the proper operation and maintenance of all the equipment furnished under this section of the specifications.

3.5 FIRE-RATED WALL PENETRATIONS

A. Where conduit penetrates fire-rated walls, the space between the penetration item and the fire barrier wall shall be properly protected. The space adjoining the conduit penetration shall be filled with a material capable of maintaining the fire rating of the fire barrier, or it shall be protected by an approved device designed for this specific purpose. Where penetrating sleeves are used, the sleeves shall be solidly set in this fire barrier wall, and the space between the conduit and the sleeve shall be filled with a material capable of maintaining the fire resistance of the fire-rated wall.

END OF SECTION 27 00 00
SECTION 27 05 29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY: Furnish and install a system of cabling supports above lay-in ceilings for network, voice, and CATV cabling as set forth hereinafter.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. J-hooks shall be utilized for support of low-voltage cabling. J-hooks shall be as follows: Use Panduit J-Pro Series non-metallic J-hooks for all horizontal cabling in all office and work areas. Steel J-hooks shall not be used.

B. Cabling support shall be located 4' to 5' on center throughout the entire length of network and CATV cabling runs above ceiling. Provide separate sets of low-voltage cabling supports along entire length of low-voltage cabling runs above ceiling to allow separation of network cabling and CATV cabling. Network cabling shall be installed in separate J-hook support system from CATV cabling. Locate supports well clear of acoustical lay-in ceiling tiles. Supports shall be located such that tiles can be removed without interfering with support system. J-hook supports shall be secured directly to metal wall studs or masonry walls, as applicable. J-hooks shall not be attached directly to gyp-board walls. J-hooks shall be located no further apart than 5'-0" on center along entire length of runs, with supports adjusted to be closer together as needed to attach to metal studs.

C. Provide all necessary supports and attachments to allow connection to structure for these supports. Provide all necessary conduits, raceways, sleeves, etc. as necessary for the installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Entire installation shall be in accordance with manufacturer’s recommendations.

B. Provide two separate sets of low-voltage cabling supports along entire length of low-voltage cabling runs above ceiling, once leaving cable tray. One set of supports shall be of Category 6 network wiring. The second set of supports shall be for CATV wiring. Locate supports well clear of acoustical lay-in ceiling tiles. Supports shall be located such that tiles can be removed without interfering with support system. Note: Additional sets of supports must be installed in parallel to the others if cabling capacities are reached or surpassed beyond TIA-569
recommendations and those of ETSU ITS. Installation shall use building hallways, corridors,
and main walking pathways as primary paths for all supports in lieu of linear cable pathways.

C. Coordinate installation of low-voltage supports with other trades as required.

END OF SECTION 27 05 29
PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide administration and labeling of entire communications infrastructure in accordance with ETSU ITS Department requirements and as set forth hereinafter. Administration and labeling shall include but not be limited to all work area outlets (WAO’s), patch panels, 110 blocks, conduits, cable trays, backbone cables, grounding and racks, etc.

1.2 REFERENCE CODES AND STANDARDS


C. TIA-569-E, Pathway and Spaces.

D. TIA-607-D, Commercial Buildings Grounding (Earthing) and Bonding Requirements for Telecommunications.

E. TIA-606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.


H. FCC 68, Connection of Terminal Equipment to the Telephone Network.

I. ADA of 2010 and Telecommunications Act of 1996, Physically Impaired and Accessibility.


   568.1-E Commercial Building Cabling
   568.2-D Copper Cabling Components
   568.3-D Fiber Cabling Components
   568.4-D Coax Cabling Components


M. ETSU Facilities Communications Infrastructure Standard (CIS) 3.1 – Policy 500.2.

O. All applicable State, Municipal, and Campus codes, standards and statutes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Products shall be as set forth elsewhere in these specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All WAO’s, patch panels, 110 blocks, conduits, cable trays, backbone cabling, outside plant cabling, grounding and racks, etc., shall be labeled according to ANSI/TIA-606-B Standards with specific labeling scheme of ETSU ITS Department. All labeling materials, methods, and schemes shall be submitted during the required submittal process. All labels shall be printed or generated by mechanical device. Labeling is also to include the following:

1. Identifiers required in Class 3 administration.
2. “Caution Fiber Optic” adhesive marker every handhole (HH). Label to include single mode (SM) and multi-mode (MM) fiber count and “to and from”.
3. “Caution Fiber Optic” adhesive marker every 50’ of exposed fiber in building (including in cable tray). Label to include SM and MM fiber count and “To and from”.
4. OSP UTP cable shall be labeled with permanent and neat penmanship in every HH and EF with “to and from” and cable pair count.
5. OSP CATV coaxial cable shall be labeled with permanent and neat penmanship in every HH and EF with “to and from”.
6. Inside the building, labeling shall include room numbers. Labels at patch panel must match labels at work area outlets (WAO). Coordinate room numbering scheme with ETSU.

END OF SECTION 27 05 53
SECTION 27 08 00 – COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. New communication infrastructure is to be tested and certified. Follow the standards of ANSI/TIA-568 for testing criteria of the permanent link. Approved testers include Fluke, Omniscanners, Fluke DSX-5000 and 4000 Series, Ideal/Lantech, and Agilent Wirescope Series.

B. Testing shall commence only after all materials are permanently installed, adjusted, bonded and labeled.

C. Testing shall commence only in clean environments, free of moisture, dirt, dust, and debris.

1.02 REFERENCE CODES AND STANDARDS


C. TIA-569-E, Pathway and Spaces.

D. TIA-607-D, Commercial Buildings Grounding (Earthing) and Bonding Requirements for Telecommunications.

E. TIA-606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.


H. FCC 68, Connection of Terminal Equipment to the Telephone Network.

I. ADA of 2010 and Telecommunications Act of 1996, Physically Impaired and Accessibility.


568.1-E Commercial Building Cabling
568.2-D Copper Cabling Components
568.3-D Fiber Cabling Components
568.4-D Coax Cabling Components

M. ETSU Facilities Communications Infrastructure Standard (CIS) 3.1 – Policy 500.2,
N. ETSU-ITS Design and Installation Standards Policy ver 3.8

PART 2 - PRODUCTS

2.01 MATERIALS

A. Products shall be as set forth elsewhere in these specifications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Warranties: Provide warranty of system as set forth hereinafter. ETSU ITS Department requires all installations to have a 25-year warranty. ETSU ITS Department has established the Hubbell’s “Mission Critical” warranty and system performance guarantee program in determining equal or equivalent warranties. Contractor shall complete the warranty information required by the Hubbell “Mission Critical” warranty and system performance guarantee program in its entirety. Information regarding the Hubbell warranty program can be found at http://www.hubbell-premise.com/missioncritical.asp. All components of this warranty program shall be filled out and returned to ETSU as part of close-out documents on the project.

B. Test Results: Provide test results as set forth hereinafter. Test results shall be produced and submitted in accordance with ETSU Facilities Communications Infrastructure Standard (CIS) Policy 500.2, Pages 20, 21.

C. As-Built Drawings: Close-out documents shall include a copy of as-built drawings on the communications installation. Communications as-built drawings shall include rack layouts, backbone wiring routings, and work area outlet (WAO) locations with all label information provided to ETSU ITS. See ETSU CIS Policy 500.2, Page 22 for requirements.

END OF SECTION 27 08 00
SECTION 27 10 20 – STRUCTURED COMMUNICATION CABELING SYSTEM

PART 1 - GENERAL

1.01 PURPOSE

A. This document defines the products and the execution requirements required to furnish and install a complete distribution system utilizing a structured cabling system.

B. All cables and related terminations, support and grounding hardware shall be furnished, installed, tested, and documented by the structured cabling installer as detailed in this document. All installation work shall be done in accordance with applicable national, state, and local building and fire codes. In addition, all work shall meet the requirements and standards of the National Fire Protection Association Life Safety Code (NFPA-LSC).

C. The distribution system shall be all inclusive and represent a complete installation at the sites shown on the attached drawings and in the attached specifications. The structured cabling installer shall be responsible for all parts, labor, and all other associated apparatus necessary to completely install, test and turnover for acceptance to the Customer the cabling system detailed herein.

D. Product specifications and general design considerations are provided in this document. Quantities of telecommunication outlets, typical installation details, cable routing and outlet types will be provided in the contract drawings. The successful structured cabling installer shall meet or exceed all requirements for the cable system described in this document and as indicated in the contract drawings.

E. Include color coding of faceplates, jacks and cables, labeling, installation, etc. per ETSU ITS standards.

1.02 REFERENCE CODES AND STANDARDS

Use the latest ratified codes and standards for the following:


C. TIA-569-E, Pathway and Spaces.

D. TIA-607-D, Commercial Buildings Grounding (Earthing) and Bonding Requirements for Telecommunications.

E. TIA-606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.


H. FCC 68, Connection of Terminal Equipment to the Telephone Network.

I. ADA of 2010 and Telecommunications Act of 1996, Physically Impaired and Accessibility.


   568.1-E Commercial Building Cabling
   568.2-D Copper Cabling Components
   568.3-D Fiber Cabling Components
   568.4-D Coax Cabling Components


M. ETSU Facilities Communications Infrastructure Standard (CIS) 3.1 – Policy 500.2,

N. ETSU-ITS Design and Installation Standards Policy ver 3.8

O. FOA Fiber Optic Association Certified Fiber Optics Technician.


Q. IEC-61300-3-35 Fiber Optic Connector Endface Visual and Automated Inspection.

R. All applicable State, Municipal, and Campus codes, standards and statutes.

S. Federal, State and local codes, rules, regulations, and ordinances governing the work, are fully part of the specifications as if herein repeated or hereto attached.

T. If the contractor should note items in the drawings or the specifications, construction of which would be a code violation(s), promptly call them to the attention of the owner's representative in writing.

U. All material shall be listed by UL or other national independent testing standard shall apply.

V. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The structured cabling installer has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
W. This document does not replace any code, either partially or wholly. The structured cabling installer must be aware of local codes that may impact this project.

1.03 INSTALLER QUALIFICATIONS

A. The structured cabling installer is responsible for workmanship and installation practices in accordance with the manufacturer's written policies.

B. The cable and connectivity manufacturer will extend a manufacturer's warranty for all products installed in this project to the end user once the structured cabling contractor fulfills all requirements under these specifications.

C. The structured cabling installer must have an office with qualified service and installation personnel within 100 miles of the project site.

D. The structured cabling installer must provide a reference list with contact names and phone numbers for three (3) projects of similar scope.

E. Structured cabling installer must be a certified contractor with the connectivity manufacturer specified in this document and be in good standing with manufacturer’s 25-year warranty program. A copy of the manufacturer’s certification documents must be submitted with the product submittals in order for such quote to be valid.

F. Structured cabling installer must have a current Registered Communications Distribution Designer (RCDD) on staff and be responsible for this project. RCDD credentials shall be submitted with bid.

G. All clean up activity related to work performed will be the responsibility of the structured cabling installer and must be completed daily before leaving the site.

H. As part of submittals, the structured cabling installer shall provide a statement of qualifications such as RCDD, Category 5e/6/6a certifications, BICSI, etc., with specific references in regards to Hubbell Certification for installation of premise wiring systems and installing the Hubbell jacks and patch panels or BICSI equivalents. Structured cabling installer shall also include documentation of authorized Corning training in installation of Corning fiber products along with documentation of continuing education.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Submit to the engineer/designer shop drawings, product data (including cut sheets and catalog information), and samples required by the contract documents. Submit shop drawings, product data, and samples with such promptness and in such sequence as to cause no delay in the work or in the activities of other contractors. Submitted shop drawings shall be initialed or signed by the structured cabling installer’s legitimate firm name.
1. By submitting shop drawings, product data, and samples, the structured cabling installer acknowledges that he/she carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also demonstrates that the structured cabling installer has checked, coordinated, and verified that information contained within shop drawings, product data, and samples conform to the requirements of the work and of the contract documents. The engineer/designer remains responsible for the design concept expressed in the contract documents as defined herein.

2. The engineer's/designer's review of shop drawings, product data, and samples submitted by the structured cabling installer shall not relieve the structured cabling installer of responsibility for deviations from requirements of the contract documents, unless the structured cabling installer has specifically informed the architect in writing of such deviation at time of submittal, and the architect has given written approval of the specific deviation. The structured cabling installer shall continue to be responsible for deviations from requirements of the contract documents not specifically noted by the structured cabling installer in writing, and specifically approved by the engineer in writing.

3. The engineer's/designer's approval of shop drawings, product data, and samples shall not relieve the structured cabling installer of responsibility for errors or omissions in such shop drawings, product data, and samples.

4. Storage and handling requirements and recommendations.

5. Installation method.

6. See other sub-sections of this division for specific submittal requirements including pre and post construction.

C. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI RCDD.

D. Submit proof from manufacturer’s good standing in manufactures warranty program.

E. Submit letter from manufacturer stating that the manufacturer will provide 25-year performance warranty that covers labor, material and applications both present and future.

F. Submit copy of structured cabling installer’s RCDD certification.

G. Test Plan: Complete and detailed plan, with list of test equipment, procedures for inspection and testing, and intended test date; submit at least ten (10) days prior to intended test date.

H. Upon request by the engineer/designer, furnish a list of references with specific information regarding type of project and involvement in providing of equipment and systems.

I. Submit references as required.

J. At completion of project, structured cabling installer shall submit the following

1. Copper certification test results, computer generated hard copy and diskettes.
2. Optical fiber power meter/light source certification test results in computer generated hard copy and in diskettes.
3. Project Record Documents: Prepared and approved by RCDD.
a. Submit scale drawings for each 1/2" = 1'0" - drawing for each telecommunications room showing all racks, patch panels, 110 blocks etc. 
b. Identify distribution frames and equipment rooms by room number on contract drawings. 

c. Copper certification test results printouts and CD’s. 
d. Optical fiber power meter/light source test results. 

e. Labeling and administration documentation. 
f. Manufacturer’s 25-year warranty certificate. 
g. All other submittal requirements as stated in the ETSU Facilities Communications Infrastructure Standard version 3.1, page 22. 

K. Work shall not proceed without the engineer's approval of the submitted items. 

L. The structured cabling installer shall receive approval from the engineer on all substitutions of material. No substituted materials shall be installed except by written approval from the engineer. 

1.05 QUALITY ASSURANCE 

A. The structured cabling installer shall be fully capable and experienced in the structured cabling system specified. The installer shall have at least 3 years’ experience in structured cabling. The installer shall have a State of Tennessee Contractor License within the electrical trade and show proof of low voltage certification. 

B. The structured cabling installer shall employ a project manager who is a RCDD. 

C. Equipment and materials of the type for which are independent standard testing requirements, listings, and labels, shall be listed and labeled by the Independent testing laboratory. 

D. Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout installation. 

E. Product Requirements: 

1. Product shall be manufactured by an ISO 9001-2000 Certified Facility. 
2. Product shall be free from defects in material and workmanship. 
3. Manufacturer must have a field representative who is industry qualified to provide quality control inspections during the life of the project. 

F. All cable and equipment shall be installed per industry standards. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of ETSU or ETSU’s representative. Equipment and materials shall be of the quality and manufacture indicated. Any equipment not specifically described shall be approved by the University prior to installation or use. The equipment is based upon the acceptable manufacturers listed.
G. Strictly adhere to all current (BICSI and TIA) installation practices when installing UTP data cabling.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Products must be stored according manufacturer’s recommendations as a minimum.

B. Keep stored products clean and dry.

C. If the structured cabling installer wishes to have a trailer on site for storage of materials, arrangements shall be made with the owner.

1.07 DRAWINGS

A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. The structured cabling installer shall make allowance in bid proposal to cover all work is required to comply with the intent of the plans and specifications.

1.08 WARRANTY

A. The structured cabling installer shall provide a manufacturer’s warranty to guarantee end-to-end high performance cabling systems that meet current and future application requirements. The guarantee shall include all labor, workmanship, horizontal and backbone cable and connectivity components, and have one point of contact for all cabling system issues. The system shall be warranted for a period of at least 25 years and shall meet or exceed the TIA standards as specified.

B. The warranty will be issued by the connectivity manufacturer only.

1.09 CLIMATIC CONDITIONS

A. When so advised by the University, the Contractor shall suspend any work that may be subject to damage by climatic conditions. The Contractor shall, at all times, provide protection against weather to prevent all work, materials, apparatus, and fixtures from injury or damage. At the end of each day's work, all new work, likely to be damaged, must be covered, or otherwise protected. It is the responsibility of the Contractor to remain aware of weather and other climatic conditions.

1.10 TEMPORARY COVERINGS

A. Finished Surfaces: The Contractor shall protect the finished surfaces against possible damage during the course of work, including jambs and soffits of openings used as passageways, or through which materials are handled.
B. Cleaning of Finished Surfaces: Finished surfaces, including factory-finished items, shall be clean and not marred upon delivery to the University. The Contractor shall, without extra compensation, refinish such spaces where surfaces prove to have been inadequately protected, resulting in damage.

C. Debris Removal: Debris shall be removed promptly from normal traffic areas, particularly in rooms and areas having finished floors of wood, resilient tile, or carpet. Further, the debris removed must not create or present a hazard or code violation in another area. The contractor shall ensure timely cleanup of all facilities and buildings related to this project, during construction and at completion.

1.11 PROTECTION OF PERSONS AND PROPERTY

A. Safety Responsibility: The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work.

B. Manhole Ventilation: The Contractor shall provide all equipment necessary to properly ventilate manholes. Tests for oxygen deficiency and harmful gasses shall be conducted in all manholes prior to entry. Furthermore, additional tests are to be conducted every two hours during working hours in the manhole. The Contractor will contact ETSU Department of Safety and Environmental Health prior to entering any OSHA defined Confined Space for further instructions.

C. Collateral Damage: The Contractor shall continuously maintain adequate protection of all work from damage and shall protect the University's property from damage or loss arising in connection with the project. The Contractor shall restore any such damage, injury, or loss, except such as may be caused by agents or employees of the University. The Contractor shall adequately protect adjacent property as provided by law.

D. Confined Space Entry: The Contractor shall request approval from the ETSU Department of Safety and Environmental Health prior to entering into any of the University’s designated confined spaces as defined by OSHA.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. As noted on drawings and in this document.

B. The materials shall be new and without any indication of damage, defect, or overage. If usually packaged, materials should be brought to the job site in the original unbroken labeled containers. The materials not specified, but required, shall be of equal or superior quality to the related parts of the work.
C. Patch panels/punch down blocks part numbers: Hubbell Premise Wiring:

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPJ48</td>
<td>2U CAT 6 48 port patchpanel (unloaded)</td>
</tr>
<tr>
<td>HPJ48</td>
<td>2U CAT 6A 48 port patchpanel (unloaded)</td>
</tr>
<tr>
<td>110BLK100FTK5</td>
<td>For ALL OSP copper: 100pr 5-pair connecting blocks</td>
</tr>
<tr>
<td>110BLK100FTK4</td>
<td>For ALL OSP copper: 100pr 4-pair connecting blocks</td>
</tr>
</tbody>
</table>

D. Modular Jack manufacturer: Hubbell Premise Wiring Xcelerator (office, work area, and general data drops)

1. Cat 6 Modular 568 Jacks: HXJ6xx
   a. Cat 6 Jack – Standard Data Jack HXJ6OR

2. Cat 6A Modular 568 Jacks: HJU6Axx (camera and Wi-Fi outlets only)
   a. Cat 6A Jack – Standard Data Jack HJU6AGN

E. Cable Manufacturers

1. Cat 6 Copper:
   a. Mohawk AdvanceNet M57202
   b. Hubbell Nextspeed C6RRB
   c. CommScope Ultra CS37R, blue

2. Cat 6A Copper:
   a. MoHawk M58816 – blue
   b. MoHawk M58894 – yellow
   c. Hubbell C6ASRB – blue
   d. Hubbell C6ASRY – yellow
   e. BerkTek 11101257 – blue
   f. BerkTek 11101266 – yellow

3. Fiber:
   a. All outside plant (OSP) fiber shall be Corning Altos, no exceptions.
   b. All inside fiber shall be Corning Freedom, no exceptions.

2.02 WORK AREA OUTLETS

A. Work area outlets shall each be terminated at their designated work area location in the connector types described below.

B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the structured cabling contractor shall submit the proposed configuration for each outlet assembly, with labeling, for review by owner.
C. The wiring and outlet termination scheme for this project shall be T568A unless otherwise directed by customer.

D. Modular Jack:
   1. Shall meet or exceed the category TIA standard of jack category required.
   2. Where color is not indicated coordinate with engineer prior to installation.

E. Modular Jack for Wireless Access Points and Cameras:
   1. Contractor shall install one (1) Category 6A cable and one (1) Category 6A green jack for each wireless access point and camera location shown on drawings.
   2. All wireless access point and camera locations will be terminated in a surface mount 2-port jack unless noted otherwise.

F. UTP Patch Cords:
   1. Category rated patch cords shall be factory terminated with modular plugs featuring a tangle-free latch design and clear strain-relief boots to support easy moves, adds and changes (MACs). Each patch cord shall be 100% performance tested at the factory to the TIA Category required standard.
   2. Patch cord shall be included in manufacturer’s 25-year warranty and defined as a channel warranty per TIA standards.
   3. Structured cabling contractor shall provide to customer at end of project:
      a. One (1) patch cord for each data cable installed in each telecommunications room. Patch cord length shall be capable of being installed from patch panel to customer equipment.
      b. One (1) 15 ft patch cord for each data cable installed in work area.
      c. One (1) Patch cord for each voice cable installed in each telecommunications room. Patch cord length shall be capable of being installed from patch panel to customer equipment.
      d. One (1) 3 ft patch cord for each wireless access point cable in work area.
      e. One (1) patch cord for each wireless access point cable installed in each telecommunications room. Patch cord length shall be capable of being installed from patch panel to customer equipment.
      f. Patch cord colors for each use shall be as specified by ETSU-ITS.

2.03 FIBER OPTIC PATCH CORDS

A. Structured cabling contractor shall provide four (4) SC to SC 3-meter multimode OM3 fiber optic patch cords for each IDF.
B. All fiber patch cords shall be factory made and part of the connectivity manufacture channel warranty.
C. Hubbell part number - DFPCSCSCE3MM

2.04 HORIZONTAL PATCH PANELS

A. All horizontal cables shall be installed on unloaded patchpanels in the communications racks as shown (see elevation drawing). All standard ETSU data cables shall be installed separately from the cables for cameras and WI-FI. (orange jacks and green jacks).
B. All patch panels shall have approved strain-relief bars installed for the support of all UTP cabling on each patch panel.

C. All data patch panels shall be 48-port unloaded design black in color.
   1. Product:
      a. Hubbell part number: Cat 6 – HPJ48 (2U)
      b. Cat A – HPJ48 (2U)

2.05 FACEPLATES

A. All data and voice work area and display faceplates shall be plastic, 4 port or indicated on drawings.

   Product: Hubbell AFP series, angled - 4-port – Color to match electrical device covers in each room. NOTE: if electrical device covers and plates are stainless steel, contractor shall match all data and voice faceplates to electrical type.

2.06 BACKBONE MDF/IDF TERMINATION BLOCK

A. The voice cross connect shall be a passive connection between the backbone termination block and the horizontal Telco 48-port patch panels located in each telecommunications rack or cabinet.

B. The wall-mount frames shall be field terminated kits including blocks, connecting blocks, designation strips and wall mount backboard channels. Single vertical channels shall wall mount between 110 wall-mount backboards to provide management of cross connect between voice extension backboard blocks and backbone voice blocks.

C. Wall-mount backbone channels shall be required where more than 599 pairs are to be terminated.

D. Shall be labeled in compliance with ANSI/TIA-606 labeling specifications using permanent labels.

E. Punch down 110 Base and System:
   1. Backbone unshielded twisted pair (UTP) cable shall be terminated upon a standard density 110 style Category 5e connecting block, providing for the termination of 25 pair cables per horizontal row. Connecting blocks shall be installed on wall mount kit with vertical cable managers.
   2. Product:
      a. Wall Mount Kit - Hubbell part number 110WMK
      b. Field Termination Kit - Hubbell part number 110BLK100FRK4
      c. Cable management troughs Hubbell part number 110TRA
2.07 BACKBONE VOICE IDC PUNCH BLOCKS

A. Terminate voice room side cables to a wall mounted 110 block.

B. ‘110’ type IDC termination bocks:
   1. Product:
      a. See ETSU-ITS policy for allowable product numbers.

2.08 LIGHTNING PROTECTION (UTP Cat 3)

A. Structured cabling contractor shall provide lightning protection for any copper communication cable installed under this contract that enters or leaves a building.
   1. Product: Circa 1880 SERIES, 110 block, 5 pin modules 3B1S-300 solid state with PTC protection.

2.09 J-HOOKS

A. The J-hook cable support shall be manufactured for use in air-handling space. The cable support must maintain complete horizontal and vertical 1" bend radius control and must manage up to 10 four pair UTP cables. Do not exceed TIA standards or manufacturer’s recommendations on number of cables installed in each cable support.
   1. Product: Panduit J-Pro series

2.10 FIBER PATCH PANEL

A. Shall mount in standard 19" EIA rack or cabinet. Shall have front and rear access on all modules via molded-hinged doors. Must have radius control and cable management for fiber patch cords. Shall have multiple cable entry locations. Include fiber optic cable routing kit (grommets, cable ties, saddle clips, strain relief bracket and ID/caution labels for various cable management solutions.
   1. Product:
      a. Outside Plant (OSP)- Corning CCH series.
      b. Inside: Hubbell Part Number FCR series- Note: size each fiber patch panel per application with room for 20% spare for future use.

2.11 MULTIMODE FIBER ADAPTER PANELS

A. All adapter panels shall use zirconia ceramic split sleeves. Use blank adapters in each empty port.

B. All ports shall be duplex SC. Coordinate with Owner equipment. Notify Owner/Engineer of discrepancy.

C. Inside ETSU standard data multimode fiber panel (non-fire alarm) shall be 50/125 um 0M3 aqua in color.
   1. Product
      a. Hubbell Bpart # HUBFSPSCDS3AQ (6-fiber)
b. Hubbell B part # HUBFSPSCDS6AQ (12-fiber)

D. Multimode fiber shall be 62.5 um for all indoor and outdoor fire alarm network use and shall utilize Corning equipment (i.e. fiber, connectors, bulkheads, housings, etc.)

2.12 SINGLEMODE FIBER ADAPTER PANELS

A. All adapter panels shall use zirconia split sleeves. Use blank adapters in each empty port. All single mode panels shall be blue in color.
   1. Product:
      a. Hubbell - part #HUBFSPSCDS3B (6-fiber) or Corning Unicam series.
      b. Hubbell - part #HUBFSPSCDS6B (12-fiber) or Corning Unicam series.

2.13 FIBER OPTIC CONNECTORS

A. Multimode fiber optic connectors shall be SC-type; 50/125.

B. Single mode fiber optic connectors shall be SC-type.
   1. Product:
      a. Hubbell - part #HUBFCSC900K50GM12 (multimode) or Corning Unicam series.
      b. Hubbell - part #HUBFCSC900KSM12 (single mode) or Corning Unicam series.

2.14 RACKS AND CABINETS

A. Furnish and install equipment racks and equipment cabinets as indicated on drawings.

B. Secure racks to floor per manufacturer’s instructions and install 18” equipment tray from top of each rack to wall as shown in drawings.

C. Ground each rack per ANSI/TIA-607-B requirements.

D. Maintain 36” clearance from the front and rear of rack and on one side.

E. If more than one (1) rack is installed, install in a line side to side, with appropriate vertical cable management on each side and between racks but should be placed adjacent to each other with no space other than the vertical management channel.
   1. Hubbell vertical wire manager part number - VS76H

F. All rack systems will contain one two unit (2U) horizontal wire manager for each copper and fiber patch panel.
   1. Hubbell horizontal wire manager – HM17C

G. Distribution Rack System:
   1. Waterfall cable management shall be provided at top of each rack for protection and to maintain proper bend radius and cable support.
      a. Waterfall cable management - Hubbell part number -HLCD18
   2. The rack shall be UL listed for 1000 lb. load rating. The rack shall be installed to support 19” equipment.
3. Each individual rack shall be equipped with 2 full length vertical managers.
   a. Product:
      1) Hubbell-Part number - CS1976 with 6” Z-channels

H. Equipment Cabinets:
   1. Approved Product: Middle Atlantic # ERK-4025-AV
   2. Cabinets shall be provided and installed as shown with all internal manufacturer- supplied components installed and functional as designed (fan kits, power strips, wire managers, etc.)

2.15 RACK BASE INSULATOR KITS
   A. Provide floor insulator kit for each rack and cabinet.

2.16 RACK-MOUNT POWER STRIP
   A. Structured cabling contractor shall install one (1) rack-mount 20 amp power strip with circuit breaker in each floor mount or wall mount rack that is served with 120 volt power.
      1. Product: Hubbell - part #MCCPSS19TS
   B. Telecommunications Grounding Busbar and Accessories.
      1. Product:
         a. Hubbell - part # HBBB14210A(SBB), part # HBBB14416H (PBB)
         b. Hubbell - part # HBBBHR19KT (rack mounted grounding bus-one for each rack)
      2. Other Products as required to meet all codes and standards.

2.17 LADDER TRAY FOR BUILDING
   A. All equipment ladder trays shall be 18" in width.
   B. Furnish and install 18" equipment tray from each floor mount rack/server cabinet to wall. Furnish and install 18" equipment tray around wall as required to support cables. (A minimum of two (2) walls shall be completely covered by equipment tray).
   C. Furnish and install cable retaining post on each side of tray every four (4) feet as required to support cables.
      1. Product:
         a. Hubbell Next Frame, 18” “HL” Series.
         b. Cooper B-Line 5B17U18B.

2.18 HORIZONTAL DISTRIBUTION CABLE
   A. All horizontal voice and data station cables shall terminate on a jack and connected in a patch panels in their respective telecommunication room or equipment room as specified on the drawings.
B. All cable, workstation jack modules and patch panel jack modules shall be the same color as designated on prints. If colors are not designated, coordinate color with engineer.
   1. UTP cabling - Horizontal Copper Cable; Category 6/6A Cable
   2. Cable construction shall be four (4) twisted pairs of 23 American Wire Gauge (AWG) insulated solid bare annealed copper conductors.
   3. Outer jacket shall meet National Electrical Code (NEC) requirements and have a nominal cable diameter not to exceed 0.235” for communications riser (CMR) and 0.225” for communications plenum (CMP).
   4. Cable shall have a minimum 1.0” bend radius.
   5. Delay Skew (max) 38ns/100m.
   6. Must have positive power sum attenuation-to-crosstalk ratio (PSACR) beyond 250 MHz.
   7. Application assurance warranty.
      a. All transmission performance parameters shall be independently verified by UL or ETL third party testing organization.
   8. Product:
      a. CommScope
      b. Hubbell
      c. Mohawk

2.19 BACKBONE COPPER CABLING SYSTEM

A. Furnish and install 24 AWG backbone cable from MDF to each IDF for voice unless otherwise indicated on backbone riser diagram. Unless otherwise indicated on drawings, size backbone cables by multiplying the number of horizontal voice cables in each IDF by 150% and rounding up to the nearest 50-pair group. Example (122 horizontal voice cables terminated in IDF1, install 122 X 1-pair X 1.50 =183 pair - round up to 200 pairs to that IDF).

2.20 BACKBONE FIBER CABLING SYSTEM

A. Furnish and install multimode and single mode fiber from MDF to IDF’s as indicated on drawings.

B. All indoor fiber shall be tight buffered interlock armored fiber. All fiber cable ends shall be supplied with fan-out kits installed prior to fiber strand termination.

C. All indoor/outdoor fiber shall be tight buffered optical fiber nonconductive plenum (OFNP) rated and shall be installed in innerduct rated for the appropriate application.

D. All outdoor fiber shall be loose tube and shall be installed in innerduct rated for the appropriate application.

E. Data multimode fiber shall be 50/125 OM4. Fire alarm multimode fiber shall be 62.5um.
F. See ETSU-ITS design and installation policy rev 3.8, Appendix ‘A’ page 37 for approved optical fiber cable types and manufacturer part numbers.

PART 3 - EXECUTION

3.01 PRE-INSTALLATION SITE SURVEY

A. Prior to start of system, meet at the project site with owner's representative and representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the general contractor will be necessary to plan the crucial schedule completions of the equipment room and telecommunication closet.

B. Examine areas and conditions under which the system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.

3.02 INSTALLATION GUIDELINES

A. The work included under this specification, consist of furnishing all labor, equipment, material, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The structured cabling installer will provide and install all of the required material to form a complete system whether specifically addressed in the technical specification or not.

B. All work performed on this project will be installed in accordance with the current edition of the NEC, the current edition of The National Electrical Safety Code, the current issue of the NEC, The current edition of ANSI/NECA/BICSI-568 standard for installing commercial building telecommunications cabling, the current edition of the BICSI Telecommunications Distribution Methods Manual (TDMM), the current edition of the BICSI Cabling Installation Manual, the latest issue of ANSI/TIA standards as published Global Engineering Documents as ANSI/TIA Telecommunications Building Wiring Standards, current revision of ETSU ITS Design and Installation Standards Policy, and all local codes and ordinances. Should conflicts exist with the foregoing, the authority having jurisdiction (AHJ) for enforcement will have responsibility for making interpretation.

C. If this document and any other documents listed above are in conflict, then the more stringent requirements shall apply. All documents listed are believed to be the most current release of the documents. The structured cabling installer has the responsibility to determine and adhere to the most current release.
D. This document does not replace any code, either partially or wholly. The structured cabling installer must be aware of local codes that may impact this project. All, local, State and federal codes are to be followed.

E. All materials shall be UL Listed or listed by other national independent testing agency and shall be marked as such.

F. Install, apply, connect, clean, and operate all materials and equipment per manufacturer’s directions and recommendations. In the even there is a conflict between specifications and manufacturer’s directions, obtain instructions from the Designer.

G. EIA/TIA 568.

H. Jacks/Panels shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination to the patch panel shall be no greater than 0.5 inches (13 mm).

I. Jacks/Panels shall be installed according to manufacturer’s instructions and properly mounted to a rack, cabinet, bracket or other appropriate mounting device.

J. Jacks/Panels shall be installed such that cables terminated to the jack/panel can maintain minimum bend radius of at least 4 times the cable diameter into the IDC contacts. Cables shall be terminated on the jacks/panels such that there is no tension on the conductors in the termination contacts.

K. Panels shall be properly labeled using labeling machine on front and back with the cable number and port connections for each port in a size that will accommodate the labeling area and is easiest to read.

3.03 WORK NOT INCLUDED

A. Unless otherwise indicated, the structured cabling installer is not responsible for providing data concentrators, hubs, switches, servers, computers, and other active devices such as PBX's.

3.04 INSTALLATION

A. Install materials and equipment in accordance with applicable standards, codes, requirements, and recommendations of national, state, and local AHJ, and current NEC and with manufacturer's instructions, in a neat and professional manner.

B. Install in accordance with manufacturer's instructions.

C. All cable shall conform to the requirements for communications circuits defined by the NEC (Article 800) and the Canadian Building Code. Cable listed to NEC Article 800-
51(a) will be used for "Plenum" installations. Cable listed to NEC Article 800-51(b) shall be installed in vertical runs penetrating more than one (1) floor.

D. Pulling tension on communications cable shall not exceed 100 Newtons or/25 foot-pounds.

E. The installer shall avoid cable stress from cable twist during installation and tension from suspended cable runs and from tightly cinched cable ties.
1. All communications cable, j-supports, conduit and trays shall be supported to the structure, independent of other services.
2. All exposed cable in the telecommunications room shall be secured to the plywood backboards or freestanding frames and routed through wire management hardware.
3. Cable should be placed in conduit or cable tray provided for this use. Cable should be supported so that no passageways are obstructed and that no doors are prevented from closing. No cable or attachments shall be installed that inhibit access to any steam line, electrical or communications cable or device or mechanical equipment.
4. When placing cable through floor sleeves or penetrations, the installer shall patch and seal all holes and gaps around the cable in accordance with fire rating.
5. Each station/backbone cable run shall be placed as an uninterrupted conductor section from origination to termination point.
6. System inspection shall be provided through pre-construction, in-progress and final inspections by the Owner. The owner or authorized representative or the Contractor may, at his/her discretion, perform tests in addition to those specified in this document if there is any reason to question the condition of the material as furnished and installed.
7. After installation is complete, in addition to any other required testing, and at such time as the Owner directs, the Contractor shall conduct an operational test for approval. The installation shall be demonstrated to be in accordance with the requirements if this specification. Any defects revealed shall be promptly corrected at Contractor’s expense and the tests re-conducted. Operational testing is defined for the following circuit types.
   a. Station cable
      1) color code compliance
      2) Labeling
      3) Routing
      4) Workmanship
      5) Compliance with EIA/TIA 568A requirements
   b. Backbone cable
      1) color code compliance
      2) Labeling
      3) Routing
      4) Workmanship
   c. Equipment room and distribution closet jumpers
      1) Patch Cords
      2) Grounding/bonding
3) Workmanship
4) Continuity of termination block layout
5) Installation and routing

d. Fiber optic cable
1) Labeling
2) Patch panel connections
3) Loss measured in dB/km
4) Workmanship
5) Splice loss
6) Connector loss
7) Circuit length

F. Install station cabling to the telecommunications room, unless otherwise noted.

G. Installation shall conform to the following basic guidelines.
1. Use of approved wire, cable, and wiring devices.
2. Neat and uncluttered wire termination.

H. Where cable tray is not used, attach cables to permanent structure with suitable attachments at intervals of 48 to 60 inches. Support cables above removable ceilings.

I. Follow manufacturer’s recommendations on spacing and number and type of cables installed in j-hooks or cable tray to avoid cable stress.

J. Separation and physical barriers between communication cabling and power cables must be maintained at all times.

K. Install adequate support structure for 10 feet of service slack at each TR.

L. Install cables in one continuous piece. Splices or taps will not be allowed.

M. Provide overvoltage protection on both ends of cabling exposed to lightning or accidental contact with power conductors.

3.05 OPTICAL FIBER CABLE

A. Installation
1. There shall be a 10-foot service loop at each end of the cable in each Telecommunications Room, preferably in cable tray per BICSI standards.
2. Any bend in any optical fiber cable at any point shall have a radius of not less than ten times the outside diameter of that cable.
3. All optical fiber cable and pathways shall be clearly identified as housing optical fiber cable at intervals not greater than 50 feet.
4. All outside plant optical fiber cable will be installed with indoor/outdoor rated loose tube rated cable, with 50’ service loop.
5. All outside plant optical fiber cable will be installed in conduit with inner duct.
6. All optical fiber cable will be installed in inner duct.
7. Part Number: MaxCell Fabric Inner duct, detectable, # MXD3456.
B. Termination
1. Tele-Communication Room
   a. All fibers will be properly broken out and buffered prior to termination.
   b. Fibers will be terminated using SC connectors.
   c. The connectors shall be mated to fiber couplings located in panels housed in rack mounted shelves

C. Testing and Inspection
1. All testing of optical fiber shall be per all applicable sections of TIA-568.
2. All testing shall comply with requirements of the ETSU Facilities Communications Infrastructure Standard ver 3.1 pages 20 thru 21.
3. All testing and certification shall be done with test equipment approved in advance by ETSU-ITS.
4. Single Mode OSP-Tier 1 and Tier 2 testing shall be required. For Tier 1, testing shall include attenuation measurement for permanent link measured with optical loss test set (OLTS) using methods specified by TIA-526-7, method A.1. For Tier 2, testing shall include additional attenuation measurement with optical time domain reflectometer (OTDR) using methods specified by TIA-526-7, method B.
5. Single Mode ISP- Tier 1 testing shall be required. Testing shall include attenuation measurement for permanent link measured with optical loss test set (OLTS) using methods specified by TIA-526-7, method A.1.
6. Multimode ISP and OSP- Tier 1 testing shall be required. For Tier 1, testing shall include attenuation measurement for permanent link measured with optical loss test set (OLTS) using methods specified by TIA-526-7, method B.
7. Optical fiber attenuation (Link Loss) Budgets shall be as follows:
   a. Single mode indoor/(outdoor)- 1.0DB @1310nm/(0.5 DB @ 1310nm). 1.0DB @ 1550nm/(0.5DB @ 1550nm).
   b. Multimode ISP and OSP- 3.5dB @ 850nm; 1.5dB @ 1300nm.
   c. Connector loss (per mated pair)- 0.75dB
   d. Splice (per each)- 0.3dB, in accordance with ANSI/TIA-455-78-B for field testing.

8. Documentation of testing shall include results, test procedure and methods, wavelengths, equipment used, calibration dates of test equipment, and names of testing personnel.
9. All testing must pass manufacturer’s specifications as well as industry standards. Cables with visible defects and deformations such as kinks, twists, or crushed cables will be considered a failed installation and will require replacement by contractor regardless of test results.
10. The installer shall ensure the proper usage of optical fiber patch cords during testing. Patch cords utilized during testing shall have the correct core to cladding offset (I.E. 50/125um vs. 62.5/125um) patch cable for the cable under test. Test results shall show calculated loss budget for each fiber length and type. Utilize mode-conditioned launch cables and fiber mandrels where applicable.
3.06 COPPER BACKBONE CABLE

A. Installation
   1. Any bend in any cable at any point shall have a radius of not less than ten times the outside diameter of that cable.
   2. The cable shall be supported in such a manner that there is only minor visible sag and shall be supported vertically with cable grips as required.
   3. A 10 foot service loop shall be provided for all copper cables.

B. Termination
   1. The cable shield shall be bonded to building steel utilizing the communications cable bonding and grounding system
   2. All cable pairs shall be terminated on rack-mount patch panels equipped with 110 punch down modules.

C. Testing and Inspection
   1. All pairs shall be tested end to end for opens, grounds, shorts, transpositions, split pairs and presence of AC current. Any cable pair not passing this test must be repaired or replaced and retested.
   2. A minimum of 10% of all riser pairs shall have a measured loss of no greater than 1 dB.
   3. All terminations shall be verified for color code accuracy.
   4. Test the continuity of bonds and grounds.
   5. Test five (5) pairs per binder for impedance matching between the backbone and station cable interfaces.

3.07 HORIZONTAL CABLE

A. Installation
   1. All cables installed from the workstation to CER/BER shall be a continuous run.
   2. A 10-foot service loop shall be in each telecommunications room for all copper cables.
   3. Quantities of cables per workstation shall be provided as indicated on the construction drawings.
   4. All cables shall be installed in accordance with manufacturer recommendations. Strict attention shall be paid to maintaining sheath integrity, avoiding cable kinks and sharp bends and proper use of cable ties.

B. Termination
   1. At the telecommunications room, cables will be terminated on rack mounted patch panels.
   2. Pair twist will be maintained as close as possible to the point of termination. Untwisting shall not exceed 13mm (0.5 inch) for Category 6/6A installations. The sheath of the cable shall be removed only as far as required to terminate the individual pairs.
3. Install all communications device plates in full contact with the wall.

C. Install all communications device plates in full contact with the wall surface.
   1. Leave 12” of cable slack above the ceiling.

D. Termination Data Cable
   1. At the telecommunications room, data cables shall be terminated on patch panels as described in the Product section of this specification.
   2. At the workstation, the data cables will be terminated as indicated in 2.09B.
   3. Pair twist will be maintained as close as possible to the point of termination. Untwisting shall not exceed 13mm (0.5 inch) for “Category 6/6A” installations. The sheath of the cable shall be removed only as far as required to terminate the individual pairs.
   4. Install all communications device plates in full contact with the wall.
   5. Leave 12” of cable slack above the ceiling.

3.08 TWO-POST RACKS

A. Racks shall be securely attached to the concrete floor using a minimum 3/8” hardware or as required by local codes.

B. Racks shall be placed with a minimum of 36 inch clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.

C. All racks shall be grounded to the telecommunications ground bar in accordance with Section B2.0.6 of this document.

D. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

E. Wall mounted termination block fields shall be mounted on 4’ x 8’ x .75” void free plywood. The plywood shall be mounted vertically 12” above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.

F. Wall mounted termination block fields shall be installed with the lowest edge of the mounting frame 18” from the finished floor.

G. Relay racks shall be provided and installed in all telecommunications rooms as specified in this document and on the construction drawings.

H. Vertical and horizontal cable management hardware shall be installed on the racks.

I. Racks shall be located within the room so as not to block access to any existing equipment or backboard space. The racks shall be located so that there is a minimum 36” access to both the front and rear of the rack.
3.09 GROUNDING AND BONDING

A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building’s electrical and building ground and shall be designed in accordance with the recommendations contained in the NEC -Telecommunications Bonding and Grounding Standard.

B. The main entrance facility/equipment room in each building shall be equipped with a Primary Bonding Busbar (PBB, formerly telecommunications main grounding bus bar (TMGB)). Each telecommunication room shall be provided with at least one Secondary Bonding Busbar (SBB, formerly telecommunications ground bus bar (TGB)). The PBB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the Telecommunications Room shall be grounded to the respective SBB or PBB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.

D. All equipment racks, CP, Enclosures, Ladder Rack, Basket Tray and Cabinets shall be bonded and grounded per ANSI/TIA-607-B, latest addition, requirements.

E. Grounding bars and related equipment shall be as follows:
1. Main Network Room Grounding Bar (PBB): Chatsworth 40153 Series or Hubbell HBB Series.
2. Part Number: HBBB14210A for the grounding bus bar in the TR.
3. Part Number: HBBB14416H for the main grounding busbar to the building ground.
4. Part Number: HBBBHR19KT for grounding of 19” equipment.
5. Part Number: HGRKTD9D for ladder racks.

F. All wires used for telecommunications grounding purposes shall be identified with green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus-bars shall be identified and labeled in accordance with the System Documentation Section of this specification.

3.10 FIRE-STOP

A. A fire-stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to
seal the penetrated structure. Fire-stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item, i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire-stopped.

C. Fire-stop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by the State Fire Marshal. A drawing showing the proposed fire-stop system shall be provided to ETSU’s Technical Representative prior to installing the fire-stop system(s) for the approval of the Fire Marshal.

D. Fire-stop used on penetrations through acoustically rated walls shall adhere to performance standards of wall prior to penetration. Apply fiberglass batt insulation or mineral wool batt insulation to achieve specified acoustical rating.

3.11 WORK AREA OUTLETs

A. Cables shall be coiled in the in-walls or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer’s bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12” of UTP and 36” of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Include one (1) meter of cable slack for each cable at end of each conduit stub out location containing UTP cabling.

B. Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568 document, manufacturer’s recommendations and best industry practices.

C. Pair untwist at the termination shall not exceed 12mm (one-half inch).

D. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.

E. The cable jacket shall be maintained as close as possible to the termination point.

3.12 BACKBONE CABLE INSTALLATION

A. Backbone cables shall be installed separately from horizontal distribution cables.

B. A pull cord (nylon; ½” minimum) shall be co-installed with all cable installed in any conduit.
C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in metallic conduit.

D. Where cables are installed in air return plenum, riser rated cable shall be installed in metallic conduit.

E. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.

F. All backbone cables shall be securely fastened to the side wall of the TR on each floor.

G. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.

H. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.

I. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cable.

3.13 IDENTIFICATION AND LABELING

A. The installer shall use the ETSU labeling system for the cable installation. ETSU will negotiate an appropriate labeling scheme with the successful installer. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cable’s origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. ALL outside plant cables including Fiber shall have cable tags attached designating source of cable, type and count. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

B. Vertical cables: terminations (110 blocks, fiber enclosures) and cables should have source-destination room and count on both ends

C. Horizontal cables (racks, 110 blocks fiber enclosures, wall jacks) should have jack-ids as required by ETSU.

D. Self-laminating labels will be used on all cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.
3.14 TESTING

A. General
1. Testing of all cable types shall conform with the requirements in the ETSU Communications Infrastructure Standard ver 3.1, pages 20 and 21. All cables with be tested under the Permanent Link format as specified by TIA568. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of TIA-568. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
2. All cables shall be tested in accordance with this document, the ANSI/TIA standards, the HPW MCCI Program Information Manual, and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Testing
1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a level III test unit for Category 6/6A performance compliance, respectively.
2. Continuity – Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturer’s recommended procedures and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
3. Length – Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
4. Category 6 Performance:
   a. Follow the Standards requirements
   b. ANSI/TIA/EIA-568-B
   c. A Level III test unit is required to verify Category 6 performance.
   d. The basic tests required are:
      1) Wire Map
      2) Length
      3) Attenuation
      4) NEXT (Near End Crosstalk)
5) Return Loss  
6) ELFEXT Loss  
7) Propagation Delay  
8) PSNEXT (Power Sum Near-End Crosstalk loss)  
9) PSELFEXT (Power Sum Equal Level Far-End Crosstalk loss)

5. Patch Panels shall be tested after horizontal cabling has been installed and terminated to both the panel and the work area outlet.

6. Panels shall be tested as part of the link or channel for Length, DC continuity, NEXT, PSNEXT, Attenuation, Return Loss, ELFEXT, and PSELFEXT using a level III tester for category 6/6A.

7. Testers shall be correctly set to test the type and manufacturer of the horizontal cable used in the link, including the correct NVP.

8. A “PASS” indication shall be obtained for all link or channel tests when tested using the appropriate level tester for the appropriate category.

C. Fiber Testing

1. All fiber testing shall be performed on all fibers in the completed end to end system. There shall be no splices unless clearly defined in construction documents. Testing shall consist of an end-to-end power meter test performed per TIA-455-53A. The system loss measurements shall be provided at 850 and/or 1300 nanometers for multimode fibers and 1310 and/or 1550 nanometers for single mode fibers. These tests also include continuity checking of each fiber.

2. Backbone multimode fiber cabling shall be tested at both 850nm and 1300nm (or 1310 and 1550 nm for single mode) in one direction.

3. Test set-up and performance shall be conducted in accordance with ANSI/TIA-526-14 Standard, Method B.

4. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. ONLY LINK TEST IS REQUIRED. The Contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above. The values for calculating loss shall be those defined in the ANSI/TIA Standard.

5. Attenuation testing shall be performed with a stable launch condition using two- meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

3.15 FIELD QUALITY CONTROL

A. Employ job superintendent or project manager during the course of the installation to provide coordination of work of this specification and of other trades, and provide technical information when requested by other trades. This person shall maintain current RCDD registration and shall be responsible for quality control during installation, equipment set- up, and testing. See page 8 of the ETSU Communications Infrastructure Standard for more requirements.
B. Installation personnel shall meet manufacturer's training and education requirements for implementation of extended warranty program.

PART 4 - DOCUMENTATION

4.01 GENERAL

A. The Contractor shall be responsible for the furnishing of all As-Built conditions to the University. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.

B. The Contractor shall provide one (1) complete set of "As-Built" drawings and CDs (CAD Files modified).

4.02 CAD REQUIREMENTS

A. The Contractor shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) file.

B. The As-Built documentation shall include the following for each OSP cable installed:
   1. Conduit route diagrams
   2. Manhole locations
   3. Conduit length and/or start and end length markings
   4. Backfilled /concrete locations
   5. Continuity verification results (Statistical Sample OK)
   6. OTDR (For Dark Fibers, Only feed Fibers need testing) (Statistical Sample OK)

C. The As-Built documentation shall include the following for each ISP Job:
   1. Cable route diagrams as separate layer on CAD Drawing
   2. Final Drop Locations as separate layer on CAD Drawing
   3. OTDR fiber test results (if any) on CD.
   4. UTP Test results (As specified by EIA/TIA Category 5e/6 Standard) on CD.

4.03 SYSTEM DOCUMENTATION

A. The Contractor shall provide three (3) full documentation sets for approval. Documentation shall include the items detailed in the sub-sections below.

B. Documentation shall be submitted at the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test results and draft as-built drawings. Draft drawings may include annotations done by hand. CAD generated (final) copies of all drawings shall be submitted at the completion of project. At the request of the University, the contractor shall provide copies of the original test results.

C. The University may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of
those defined above. If findings contradict the documentation submitted by the contractor, additional testing can be requested to the extent determined necessary by the University, including a 100% re-test. This re-test shall be at no additional cost to ETSU.

4.04 TEST RESULTS

A. Test documentation shall be provided on disk or flash drive within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words “Project Test Documentation”, the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

B. The field test equipment shall meet the requirements of ANSI/NECA/BICSI-568. The appropriate level tester shall be used to verify Category 6/6A cabling systems.

C. Test results generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The structured cabling installer must furnish this information in electronic form in original tester format as well as PDF.

D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

4.05 AS-BUILTS

A. See ETSU Communications Infrastructure Standard ver 3,1, page 22 for all requirements.

END OF SECTION 27 10 20
SECTION 27 11 00 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install communications terminal spaces as indicated on drawings and as called for hereinafter.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. The communications terminal spaces shall consist of ¾” AC grade plywood bolted to all walls of the room with the top 6’ above floor and the bottom 24” above floor. The ‘A’ grade or ‘prime’ graded side with least defects shall face the interior of the room. Provide Unistrut channel above and below the plywood to secure inbound and outbound conduit. Conduit at that location shall be fitted with bushings. Conduit shall be terminated in a horizontal position within 6" of the terminal mounting board. Paint plywood with two coats of fire resistant paint. Fire resistant paint shall be Benjamin Moore M59-220 (white) or Sherwin Williams MIL-PRF-24596B (white 27880), with up to 2 ounces of tint allowed per gallon.

B. At Network Room CTS location, furnish and install a grounding bus bar. Grounding bus bar shall be as illustrated on drawings.

2.2 BOXES

A. Sheet Metal Outlet and Device Boxes: Comply with UL 514A.

B. Nonmetallic Outlet and Device Boxes: Comply with UL 514C.

C. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

D. Device Box Dimensions: 4-11/16 inches SQ x 3”.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install grounding at Network Room. Refer to drawings for additional information.

END OF SECTION 27 11 00
PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install a complete a 1 GHz CATV wiring system as described on drawings and called for hereinafter.

B. The catalog numbers specified herein are those of the Blonder-Tongue Company and constitute the type and quality of the products to be installed.

C. The quality and type of CATV materials must be accepted by industry standards. All passive and active equipment must be two-way and pass signals up to one GHZ "passive" and 750 MHZ "active".

D. Cable tray shown in drawings and specs is for UTP and coaxial cabling on the ETSU network only. All other systems including A/V, paging, alarm, proprietary networks, and other cables must utilize their own cable tray and j-hook support system.

1.02 INSTALLER QUALIFICATIONS

A. Installation of CATV cabling system shall be done by personnel regularly engaged in installation of such facilities. Installers shall have NCTI, SCTE, and BICSI certifications. Provide documentation of these certifications as part of the submittal process. Installer shall have working knowledge of all codes/standards related to CATV wiring installation.

1.03 DISTRIBUTION LEVELS

A. Line extender outputs shall be 46/40 DBMV for single cascade, and 43/37 DBMV for two cascades. No more than two line extenders shall be provided in cascade. Tap levels shall not exceed 17 DBMV on any "F" fitting. Typical tap level shall be 12 DBMV. Output level at faceplate shall be 3 DBMV and maximum of 10 DBMV. Maximum 3 DB variation shall be allowed between adjacent channels.

1.04 REFERENCE STANDARDS

A. SECTION 27.01.00 – REFERENCE STANDARDS

B. ANSI/SCE 74 2003, Specification for braided 75 ohm Flexible Coaxial Cable.

C. FCC Part 76, Cable Television Service.
PART 2- PRODUCTS

2.01 MATERIALS

A. Splitters: In the Telecommunications Room, install splitters to take the cable TV feed and distribute it to each individual room. Splitters/combiners shall be vertical ports, capable of passing one GHz signal with built-in grounding lug, Truespec DSVXG or equivalent. "X" represents the number of ports. Arrange splitters/combiners so that signal is evenly distributed among all ports.

B. Wall Plates: Wall plates for CATV outlets shall be flush mounted with single-gang Standard F81 through connector with 0 db isolation, Hubbell AFP series.

C. Coaxial Cable: Coaxial cable shall be installed from each television outlet location shown on drawings to the Telecommunications Room on a homerun basis. No series wiring for TV shall be permitted. The coaxial cable from the outlet to the Telecommunications Room shall be Belden 7915A Series RG6 cable, aluminum braid shield, flame retardant PVC jacket meeting NEC Article 820V rating, ETL listed or equivalent.

D. Coaxial Connectors: Use compression type, Belden Thomas and Betts FSNS6U.

E. Amplifier: Provide one amplifier in Telecommunications Room. Each amplifier shall be two-way broadband distribution amplifier, Blonder-Tongue Model No. BIDA-750-30 or 750-50 as directed by ITS.

F. Riser Coax installation:
   1. Riser Coax shall be RG11 Belden 9011 if under 300 feet and Comscope PIII 500 Plenum over 300ft.
   2. RG11 Fitting shall be Thomas and Betts 716SNS1P11H
   3. Coax.500 Series Fitting shall be Gilbert GRS-500-CH-DU-03-T
   4. Coax F-to-F adapter shall be Gilbert G-CH-BAFF-KS

PART 3- EXECUTION

3.01 INSTALLATION

A. Each coaxial cable shall be tested for signal loss, length of cable, and meet the manufacturers specifications. Testing shall be in accordance with FCC Part 76 signal leakage requirements. Coaxial cable tests will involve continuity and RF leakage, 20-uV/m leakage limit (10 feet from network). Limit will yield a dipole level of -43.67 dBmV 75 ohms. Carefully coordinate tie-in of incoming line with local cable operator. Complete TV feed to each individual outlet to verify that a proper signal is being distributed. After proper documentation disconnect each room at the headend location and make each connection for proper identification.
B. Cable drops shall be bundled by use of approved plastic ties. Tape shall not be permitted to bundle cable drops.

C. Grounding will meet NEC requirements for CATV. Refer to Article 820 of the National Electrical Code for information.

END OF SECTION 27 15 33
SECTION 28 46 21.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

1.1 SUMMARY

A. Section Includes:

1. Existing fire-alarm system to be modified.
2. Addressable fire-alarm system.
3. Fire-alarm control unit (FACU).
5. System smoke detectors.
6. Magnetic Door Holders
7. Fire-alarm notification appliances.
8. Fire-alarm remote annunciators.

1.2 ACTION SUBMITTALS

A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.

B. Shop Drawings: For fire-alarm system.
   1. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
      a. Show field wiring and equipment required for HVAC unit shutdown on alarm.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

   1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
   2. Installation must be by personnel certified by NICET as fire-alarm Level III technician.
   3. Licensed or certified by authorities having jurisdiction.
1.6 FIELD CONDITIONS

A. Seismic Conditions: Unless otherwise indicated on Contract Documents, specified Work in this Section must withstand the seismic hazard design loads determined in accordance with ASCE for installed elevation above or below grade.

1. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic design loads and unit must be fully operational after seismic event."

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.8 PRODUCTS

A. Existing Fire-Alarm System To Be Modified:

1. Basis for Pricing: Simplex (; model number 4100U.
2. Description: Audio visual addressable fire alarm system with a Fire Communicator

B. Addressable Fire-Alarm System:

1. Description:
   a. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

2. Performance Criteria:
   a. Regulatory Requirements:
      1) Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

      b. General Characteristics:
         1) Fire-alarm signal must initiate the following actions:
            a) Continuously operate alarm notification appliances.
            b) Identify alarm and specific initiating device at FACU and remote annunciators.
2) System Supervisory Signal Actions:
   a) Identify specific device initiating event at FACU and remote annunciators.
   b) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.

3) Network Communications:
   a) Existing to remain.

C. Fire-Alarm Control Unit (FACU):

   1. Description: Existing Simplex 4100U Fire alarm Panel.
   2. Performance Criteria:

      a. Regulatory Requirements: Comply with NFPA 72 and UL 864.
      b. Fire-Alarm Annunciator:

         1) Annunciator and Display: LCD, 80 characters, minimum.

      c. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

         1) Pathway Class Designations: NFPA 72, Class B
         2) Pathway Survivability: Level 0
         3) Install no more than 100 addressable devices on each signaling-line circuit.

      d. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must be connected to fire-alarm system.

      e. Remote smoke-detector sensitivity adjustment.

      f. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals must be powered by 24 V(dc) source.

         1) Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.

      g. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.

         1) Batteries: Sealed lead calcium.

3. Accessories:

   a. Instructions.

D. Manual Fire-Alarm Boxes:

   1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
a. Double-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.

E. System Smoke Detectors:

1. Photoelectric Smoke Detectors:

   a. Performance Criteria:

      1) Regulatory Requirements:

         a) NFPA 72.
         b) UL 268.

      2) Detectors must be two-wire type.

      3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.

      4) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.

      5) Detector must have functional humidity range within 10 to 90 percent relative humidity.


      7) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.

F. Magnetic Door Holders:

1. Performance Criteria:

   a. Regulatory Requirements:

      1) NFPA 72
      2) UL 228 – Door holders for Fire Protective Signaling Systems

   b. Units are equipped for wall mounting as indicated are complete with matching doorplate.

   c. Units are rated for 24V and powered by the Fire alarm panel.

   d. Units are designed to release doors held open upon activation of local smoke detector.

G. Fire-Alarm Notification Appliances:
1. Fire-Alarm Audible Notification Appliances:
   a. Description: Horns, bells, or other notification devices that cannot output voice messages.
   b. Performance Criteria:
      1) Regulatory Requirements:
         a) NFPA 72.
      2) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
      3) Sounders, Low Volume 24 V(dc): Less than 4 mA of alarm current.
      4) Audible notification appliances must have functional humidity range of 10 to 95 percent relative humidity.
      5) ISO Temporal 3 Alert Tone: 95 plus or minus 5 dB(A-weighted) at 24 V.
      6) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

2. Fire-Alarm Visible Notification Appliances:
   a. Performance Criteria:
      1) Regulatory Requirements:
         a) NFPA 72.
         b) UL 1971.
      2) Rated Light Output:
         a) 15/30/75/110 cd, selectable in field.
         b) Mounting Faceplate: Factory finished, red.
      3) Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
      4) Secondary Power: Integral rechargeable battery and automatic charger.

1.9 EXECUTION
A. Preparation:
   1. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service in accordance with requirements indicated:
a. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
b. Do not proceed with interruption of fire-alarm service without Owner's written permission.

B. Installation of Equipment:
   1. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
      a. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to new points. New components must be capable of merging with existing configuration without degrading performance of either system.

C. Electrical Connections:
   1. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
      a. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."

D. Pathways:
   1. Pathways must be installed in EMT.
   2. Exposed EMT must be painted red enamel.

E. Connections:
   1. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 08 71 00 "Door Hardware." Connect hardware and devices to fire-alarm system.
      a. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

F. Field Quality Control:
   1. Field tests must be witnessed by Architect and authorities having jurisdiction.
   2. Adminstrant for Tests and Inspections:
      a. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
   3. Tests and Inspections:
      a. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in
NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

4. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

5. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

G. Demonstration:

1. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

H. Maintenance:

1. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization.