PROJECT MANUAL

QUARANTINE SUPPORT BUILDING
at
BRANDYWINE ZOO
1001 N. Park Drive
Wilmington, DE 19802
for

Department of Natural Resources and Environmental Control

Division of Parks and Recreation
89 Kings Highway
Dover, DE 19901

DNREC Project: WBZ-9

Prepared by

Architect
GWWO, Inc.
800 Wyman Park Drive, Suite 300
Baltimore, MD 21211

100% Construction Document Submission
June 2, 2020
Specifications for this project are arranged in accordance with the Construction Specification Institute numbering system and format. Section numbering is discontinuous and all numbers not appearing in the Table of Contents are not used for this Project.

DOCUMENTS BOUND HEREWITH

<table>
<thead>
<tr>
<th>Division .... Section Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERIES 0 – PROCUREMENT AND CONTRACT REQUIREMENTS</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTORY INFORMATION</td>
<td></td>
</tr>
<tr>
<td>00 01 01 PROJECT TITLE PAGE</td>
<td>6</td>
</tr>
<tr>
<td>00 01 10 TABLE OF CONTENTS</td>
<td></td>
</tr>
<tr>
<td>00 01 15 LIST OF DRAWINGS</td>
<td>1</td>
</tr>
<tr>
<td>PROCUREMENT REQUIREMENTS</td>
<td></td>
</tr>
<tr>
<td>00 11 16 INVITATION TO BID</td>
<td>1</td>
</tr>
<tr>
<td>00 21 13 INSTRUCTIONS TO BIDDERS</td>
<td>13</td>
</tr>
<tr>
<td>00 41 13 BID FORM</td>
<td>8</td>
</tr>
<tr>
<td>00 43 13 BID BOND</td>
<td>1</td>
</tr>
<tr>
<td>CONTRACTING REQUIREMENTS</td>
<td></td>
</tr>
<tr>
<td>00 52 13 STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017</td>
<td>16</td>
</tr>
<tr>
<td>00 54 13 SUPPLEMENT TO AGREEMENT BETWEEN OWNER &amp; CONTRACTOR A101-2017</td>
<td>1</td>
</tr>
<tr>
<td>00 54 14 SUPPLEMENT TO A101-2017 – EXHIBIT A – INSURANCE &amp; BONDS</td>
<td>1</td>
</tr>
<tr>
<td>00 61 13.13 PERFORMANCE BOND</td>
<td>2</td>
</tr>
<tr>
<td>00 61 13.16 PAYMENT BOND</td>
<td>2</td>
</tr>
<tr>
<td>00 62 76 APPLICATION OF PAYMENT (SAMPLE AIA G702 &amp; G703)</td>
<td>2</td>
</tr>
<tr>
<td>00 72 13 GENERAL CONDITIONS TO THE CONTRACT (AIA A201-2017)</td>
<td>41</td>
</tr>
<tr>
<td>00 73 13 SUPPLEMENTARY GENERAL CONDITIONS</td>
<td>15</td>
</tr>
<tr>
<td>00 73 46 DELAWARE DEPARTMENT OF LABOR PREVAILING WAGE RATES CLASSIFICATION OF WORKERS UNDER DELAWARE’S PREVAILING WAGE RATES</td>
<td>4</td>
</tr>
<tr>
<td>00 81 13 GENERAL REQUIREMENTS</td>
<td>16</td>
</tr>
<tr>
<td>00 81 14 DRUG TESTING FORMS</td>
<td>2</td>
</tr>
<tr>
<td>DIVISION 1 – GENERAL REQUIREMENTS</td>
<td></td>
</tr>
<tr>
<td>01 10 00 SUMMARY</td>
<td>6</td>
</tr>
<tr>
<td>01 14 00 WORK RESTRICTIONS</td>
<td>2</td>
</tr>
<tr>
<td>01 22 00 UNIT PRICES</td>
<td>2</td>
</tr>
<tr>
<td>01 23 00 ALTERNATES</td>
<td>2</td>
</tr>
<tr>
<td>01 24 00 PERMITS</td>
<td>2</td>
</tr>
<tr>
<td>01 25 00 CONTRACT MODIFICATION PROCEDURES</td>
<td>2</td>
</tr>
<tr>
<td>01 29 00 PAYMENT PROCEDURES</td>
<td>3</td>
</tr>
<tr>
<td>01 31 00 PROJECT MANAGEMENT AND COORDINATION</td>
<td>3</td>
</tr>
<tr>
<td>01 31 50 FIELD ENGINEERING</td>
<td>2</td>
</tr>
<tr>
<td>01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION</td>
<td>4</td>
</tr>
<tr>
<td>01 32 23 PHOTOGRAPHIC DOCUMENTATION</td>
<td>2</td>
</tr>
<tr>
<td>01 33 00 SUBMITTAL PROCEDURES</td>
<td>11</td>
</tr>
</tbody>
</table>

TABLE OF CONTENTS 00 01 00 - 1
<table>
<thead>
<tr>
<th>Item Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 40 00</td>
<td>QUALITY REQUIREMENTS</td>
<td>8</td>
</tr>
<tr>
<td>01 42 00</td>
<td>REFERENCE STANDARDS AND DEFINITIONS</td>
<td>4</td>
</tr>
<tr>
<td>01 50 00</td>
<td>TEMPORARY FACILITIES AND CONTROLS</td>
<td>11</td>
</tr>
<tr>
<td>01 56 00</td>
<td>ENVIRONMENTAL PROTECTION</td>
<td>3</td>
</tr>
<tr>
<td>01 56 39</td>
<td>TREE PROTECTION</td>
<td>6</td>
</tr>
<tr>
<td>01 60 00</td>
<td>PRODUCT REQUIREMENTS</td>
<td>10</td>
</tr>
<tr>
<td>01 71 17</td>
<td>ANIMAL MANAGEMENT REQUIREMENTS OF CONSTRUCTION</td>
<td>2</td>
</tr>
<tr>
<td>01 73 00</td>
<td>EXECUTION REQUIREMENTS</td>
<td>6</td>
</tr>
<tr>
<td>01 73 29</td>
<td>CUTTING AND PATCHING</td>
<td>4</td>
</tr>
<tr>
<td>01 74 19</td>
<td>CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL</td>
<td>9</td>
</tr>
<tr>
<td>01 77 00</td>
<td>CLOSEOUT PROCEDURES</td>
<td>6</td>
</tr>
<tr>
<td>01 78 23</td>
<td>MAINTENANCE DATA</td>
<td>4</td>
</tr>
<tr>
<td>01 78 39</td>
<td>PROJECT RECORD DOCUMENTS</td>
<td>4</td>
</tr>
<tr>
<td>01 79 00</td>
<td>DEMONSTRATION AND TRAINING</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>DIVISION 2 – EXISTING CONDITIONS</strong></td>
<td></td>
</tr>
<tr>
<td>02 32 00</td>
<td>GEOTECHNICAL INVESTIGATION</td>
<td>36</td>
</tr>
<tr>
<td>02 41 00</td>
<td>SELECTIVE DEMOLITION</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td><strong>DIVISION 3 – CONCRETE</strong></td>
<td></td>
</tr>
<tr>
<td>03 30 00</td>
<td>CAST-IN-PLACE CONCRETE</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td><strong>DIVISION 4 – MASONRY</strong></td>
<td></td>
</tr>
<tr>
<td>04 20 00</td>
<td>UNIT MASONRY</td>
<td>21</td>
</tr>
<tr>
<td>04 43 13</td>
<td>STONE MASONRY VENEER</td>
<td>7</td>
</tr>
<tr>
<td>04 72 00</td>
<td>CAST STONE MASONRY</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>DIVISION 5 – METALS</strong></td>
<td></td>
</tr>
<tr>
<td>05 05 00</td>
<td>POST INSTALLED ANCHORAGE</td>
<td>5</td>
</tr>
<tr>
<td>05 12 00</td>
<td>STRUCTURAL STEEL FRAMING</td>
<td>10</td>
</tr>
<tr>
<td>05 31 00</td>
<td>STEEL DECKING</td>
<td>8</td>
</tr>
<tr>
<td>05 40 00</td>
<td>COLD-FORMED METAL FRAMING</td>
<td>13</td>
</tr>
<tr>
<td>05 50 00</td>
<td>METAL FABRICATIONS</td>
<td>6</td>
</tr>
<tr>
<td>05 51 00</td>
<td>METAL STAIRS</td>
<td>4</td>
</tr>
<tr>
<td>05 52 13</td>
<td>PIPE AND TUBE RAILINGS</td>
<td>4</td>
</tr>
<tr>
<td>05 59 64</td>
<td>GALVANIZED STEEL ANIMAL CAGING &amp; KEEPER GATES</td>
<td>8</td>
</tr>
<tr>
<td>05 59 66</td>
<td>GALVANIZED ANIMAL TRANSFER DOOR ASSEMBLIES</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td><strong>DIVISION 6 – WOOD, PLASTICS AND COMPOSITES</strong></td>
<td></td>
</tr>
<tr>
<td>06 10 00</td>
<td>ROUGH CARPENTRY</td>
<td>7</td>
</tr>
<tr>
<td>06 16 00</td>
<td>SHEATHING</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>DIVISION 7 – THERMAL AND MOISTURE PROTECTION</strong></td>
<td></td>
</tr>
<tr>
<td>07 13 00</td>
<td>SHEET WATERPROOFING</td>
<td>5</td>
</tr>
<tr>
<td>07 21 00</td>
<td>THERMAL INSULATION</td>
<td>5</td>
</tr>
<tr>
<td>07 25 00</td>
<td>WEATHER BARRIERS</td>
<td>3</td>
</tr>
<tr>
<td>07 46 23</td>
<td>WOOD SIDING</td>
<td>3</td>
</tr>
<tr>
<td>07 54 23</td>
<td>THERMOPLASTIC POLYOLEFIN ROOFING</td>
<td>12</td>
</tr>
<tr>
<td>07 62 00</td>
<td>SHEET METAL FLASHING AND TRIM</td>
<td>3</td>
</tr>
<tr>
<td>07 72 00</td>
<td>ROOF ACCESSORIES</td>
<td>3</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

## 07 92 00 Joint Sealants

### Division 8 – Openings
- 08 16 13 Fiberglass Doors
- 08 54 13 Fiberglass Windows
- 08 71 00 Door Hardware
- 08 80 00 Glazing
- 08 91 00 Louvers

### Division 9 – Finishes
- 09 21 16 Gypsum Board Assemblies
- 09 22 16 Non-Structural Metal Framing
- 09 22 36.23 Metal Lath
- 09 24 00 Cement Plastering
- 09 51 00 Acoustical Ceilings
- 09 67 00 Fluid-Applied Flooring
- 09 91 13 Exterior Painting
- 09 96 00 High Performance Coatings

### Division 10 – Specialties
- 10 14 00 Signage (Not included in DD Submission)
- 10 28 00 Toilet, Bath and Laundry Accessories
- 10 44 00 Fire Protection Specialties
- 10 51 13 Metal Lockers
- 10 56 13 Metal Storage Shelving
- 10 57 23 Closet and Utility Shelving

### Division 11 (Not Used)

### Division 12 - Furnishings
- 12 21 13 Horizontal Louver Blinds
- 12 31 00 Manufactured Metal Casework

### Divisions 13 Thru 21 (Not Used)

### Division 22 – Plumbing
- 22 01 01 Plumbing General Provisions
- 22 05 00 Common Work Results for Plumbing
- 22 05 01 Excavation and Fill for Plumbing Work
- 22 05 02 Sleeves and Plates for Plumbing Piping
- 22 05 06 Curbs and Flashings for Plumbing Piping and Equipment
- 22 05 09 Plumbing Expansion System
- 22 05 13 Common Motor Requirements for Plumbing Equipment
- 22 05 19 Meters and Gages for Plumbing Piping
- 22 05 23 General-Duty Valves for Plumbing Piping
- 22 05 29 Hangers and Supports for Plumbing Piping and Equipment
- 22 05 48 Vibration Control Supports for Plumbing
- 22 07 00 Plumbing Insulation
- 22 07 19 Plumbing Piping Insulation
<table>
<thead>
<tr>
<th>Division</th>
<th>Table of Contents</th>
</tr>
</thead>
<tbody>
<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 11 23</td>
<td>DOMESTIC WATER PUMPS</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 14 13</td>
<td>STORM DRAINAGE PIPING</td>
</tr>
<tr>
<td>22 14 23</td>
<td>STORM DRAINAGE PIPING SPECIALTIES</td>
</tr>
<tr>
<td>22 34 00</td>
<td>FUEL-FIRED DOMESTIC WATER HEATERS</td>
</tr>
<tr>
<td>22 42 00</td>
<td>INSTITUTIONAL PLUMBING FIXTURES</td>
</tr>
<tr>
<td>22 70 00</td>
<td>ANIMAL WATERER SYSTEMS</td>
</tr>
</tbody>
</table>

**DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING**

<table>
<thead>
<tr>
<th>Division</th>
<th>Table of Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 01 00</td>
<td>OPERATION AND MAINTENANCE OF HVAC SYSTEMS</td>
</tr>
<tr>
<td>23 01 01</td>
<td>HVAC GENERAL PROVISIONS</td>
</tr>
<tr>
<td>23 05 00</td>
<td>COMMON WORK RESULTS FOR HVAC</td>
</tr>
<tr>
<td>23 05 01</td>
<td>EXCAVATION AND FILL FOR HVAC WORK</td>
</tr>
<tr>
<td>23 05 02</td>
<td>SLEEVES AND PLATES FOR HVAC PIPING</td>
</tr>
<tr>
<td>23 05 06</td>
<td>CURBS AND FLASHINGS FOR HVAC EQUIPMENT</td>
</tr>
<tr>
<td>23 05 08</td>
<td>HVAC PIPING SPECIALTIES</td>
</tr>
<tr>
<td>23 05 09</td>
<td>HVAC EXPANSION SYSTEMS</td>
</tr>
<tr>
<td>23 05 13</td>
<td>COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT</td>
</tr>
<tr>
<td>23 05 19</td>
<td>METERS AND GAGES FOR HVAC</td>
</tr>
<tr>
<td>23 05 23</td>
<td>GENERAL-DUTY VALVES FOR HVAC PIPING</td>
</tr>
<tr>
<td>23 05 29</td>
<td>HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT</td>
</tr>
<tr>
<td>23 05 48</td>
<td>VIBRATION CONTROL SUPPORTS FOR HVAC</td>
</tr>
<tr>
<td>23 05 93</td>
<td>TESTING, ADJUSTING AND BALANCING</td>
</tr>
<tr>
<td>23 07 00</td>
<td>HVAC INSULATION</td>
</tr>
<tr>
<td>23 07 13</td>
<td>DUCT INSULATION</td>
</tr>
<tr>
<td>23 07 16</td>
<td>HVAC EQUIPMENT INSULATION</td>
</tr>
<tr>
<td>23 07 19</td>
<td>HVAC PIPING INSULATION</td>
</tr>
<tr>
<td>23 08 00</td>
<td>SYSTEMS COMMISSIONING</td>
</tr>
<tr>
<td>23 09 01</td>
<td>AUTOMATIC TEMPERATURE CONTROL SYSTEM</td>
</tr>
<tr>
<td>23 09 02</td>
<td>CONTROL SYSTEMS WIRING</td>
</tr>
<tr>
<td>23 09 07</td>
<td>CONTROL DAMPERS</td>
</tr>
<tr>
<td>23 09 08</td>
<td>CONTROL VALVES</td>
</tr>
<tr>
<td>23 09 13</td>
<td>INSTRUMENTATION AND CONTROL DEVICES FOR HVAC</td>
</tr>
<tr>
<td>23 09 23</td>
<td>DIRECT DIGITAL BUILDING SYSTEMS CONTROL</td>
</tr>
<tr>
<td>23 11 26</td>
<td>LIQUEFIED-PETROLEUM GAS PIPING</td>
</tr>
<tr>
<td>23 21 13</td>
<td>HYDRONIC PIPING</td>
</tr>
<tr>
<td>23 21 23</td>
<td>HVAC PUMPS</td>
</tr>
<tr>
<td>23 23 00</td>
<td>REFRIGERANT PIPING</td>
</tr>
<tr>
<td>23 31 13</td>
<td>METAL DUCTS</td>
</tr>
<tr>
<td>23 33 00</td>
<td>DUCT ACCESSORIES</td>
</tr>
<tr>
<td>23 34 00</td>
<td>HVAC FANS</td>
</tr>
<tr>
<td>23 36 00</td>
<td>AIR TERMINAL UNITS</td>
</tr>
<tr>
<td>23 37 13</td>
<td>DIFFUSERS, REGISTERS, AND GRILLES</td>
</tr>
<tr>
<td>23 41 00</td>
<td>PARTICULATE AIR FILTRATION</td>
</tr>
<tr>
<td>23 52 16</td>
<td>CONDENSING BOILERS</td>
</tr>
<tr>
<td>23 81 26</td>
<td>SPLIT-SYSTEM AIR-COOLING UNITS</td>
</tr>
<tr>
<td>23 81 27</td>
<td>DUCTLESS SPLIT-SYSTEM UNITS</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>23 82 39</td>
<td>UNIT HEATERS</td>
</tr>
<tr>
<td>23 84 13</td>
<td>HUMIDIFIERS</td>
</tr>
</tbody>
</table>

**DIVISION 26 – ELECTRICAL**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 01 01</td>
<td>ELECTRICAL GENERAL PROVISIONS</td>
<td>12</td>
</tr>
<tr>
<td>26 05 00</td>
<td>COMMON WORK RESULTS FOR ELECTRICAL</td>
<td>5</td>
</tr>
<tr>
<td>26 05 01</td>
<td>EXCAVATION AND FILL FOR ELECTRICAL WORK</td>
<td>5</td>
</tr>
<tr>
<td>26 05 03</td>
<td>ACCESS DOORS FOR ELECTRICAL SYSTEMS</td>
<td>2</td>
</tr>
<tr>
<td>26 05 04</td>
<td>ELECTRICAL DEMOLITION</td>
<td>2</td>
</tr>
<tr>
<td>26 05 07</td>
<td>FIRESTOPPING FOR ELECTRICAL WORK</td>
<td>5</td>
</tr>
<tr>
<td>26 05 19</td>
<td>WIRES AND CABLES</td>
<td>11</td>
</tr>
<tr>
<td>26 05 21</td>
<td>WIRING CONNECTIONS</td>
<td>2</td>
</tr>
<tr>
<td>26 05 26</td>
<td>GROUNDING AND BONDING</td>
<td>5</td>
</tr>
<tr>
<td>26 05 28</td>
<td>EQUIPMENT FOUNDATIONS</td>
<td>2</td>
</tr>
<tr>
<td>26 05 33</td>
<td>CONDUITS</td>
<td>11</td>
</tr>
<tr>
<td>26 05 34</td>
<td>BOXES</td>
<td>3</td>
</tr>
<tr>
<td>26 05 41</td>
<td>LOW-VOLTAGE SERVICE ENTRANCE</td>
<td>3</td>
</tr>
<tr>
<td>26 05 44</td>
<td>UNDERGROUND DUCTS AND UTILITY STRUCTURES</td>
<td>7</td>
</tr>
<tr>
<td>26 05 53</td>
<td>IDENTIFICATION FOR ELECTRICAL SYSTEMS</td>
<td>9</td>
</tr>
<tr>
<td>26 05 73</td>
<td>OVERCURRENT PROTECTIVE DEVICE STUDIES</td>
<td>9</td>
</tr>
<tr>
<td>26 09 23</td>
<td>STAND-ALONE LIGHTING CONTROL DEVICES</td>
<td>7</td>
</tr>
<tr>
<td>26 09 32</td>
<td>TUNABLE WHITE LIGHTING CONTROL SYSTEM</td>
<td>9</td>
</tr>
<tr>
<td>26 09 36</td>
<td>MODULAR LIGHTING CONTROLS</td>
<td>12</td>
</tr>
<tr>
<td>26 24 16</td>
<td>PANELBOARDS</td>
<td>9</td>
</tr>
<tr>
<td>26 27 16</td>
<td>CABINETS AND ENCLOSURES</td>
<td>2</td>
</tr>
<tr>
<td>26 27 26</td>
<td>WIRING DEVICES</td>
<td>3</td>
</tr>
<tr>
<td>26 28 00</td>
<td>ENCLOSED CIRCUIT PROTECTIVE DEVICES</td>
<td>3</td>
</tr>
<tr>
<td>26 28 13</td>
<td>FUSES</td>
<td>2</td>
</tr>
<tr>
<td>26 29 14</td>
<td>ENCLOSED MOTOR CONTROLLERS</td>
<td>3</td>
</tr>
<tr>
<td>26 29 23</td>
<td>VARIABLE FREQUENCY DRIVES</td>
<td>12</td>
</tr>
<tr>
<td>26 32 13</td>
<td>GENERATORS, WEATHER-PROTECTED</td>
<td>19</td>
</tr>
<tr>
<td>26 36 00</td>
<td>TRANSFER SWITCHES</td>
<td>10</td>
</tr>
<tr>
<td>26 43 13</td>
<td>SURGE PROTECTIVE DEVICES</td>
<td>6</td>
</tr>
<tr>
<td>26 51 00</td>
<td>INTERIOR LIGHTING</td>
<td>7</td>
</tr>
<tr>
<td>26 56 00</td>
<td>EXTERIOR LIGHTING</td>
<td>4</td>
</tr>
</tbody>
</table>

**DIVISION 27 - COMMUNICATIONS** (NOT USED)

**DIVISION 28 - ELECTRONIC SAFETY AND SECURITY**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 31 00</td>
<td>FIRE DETECTION AND ALARM SYSTEMS</td>
<td>11</td>
</tr>
</tbody>
</table>

**DIVISION 31 – EARTHWORK**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 10 00</td>
<td>SITE CLEARING</td>
<td>4</td>
</tr>
<tr>
<td>31 20 00</td>
<td>EARTHWORK SITE</td>
<td>12</td>
</tr>
<tr>
<td>31 23 19</td>
<td>DEWATERING</td>
<td>6</td>
</tr>
</tbody>
</table>

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 12 16</td>
<td>HOT-MIX ASPHALT PAVING</td>
<td>4</td>
</tr>
<tr>
<td>32 31 00</td>
<td>DECORATIVE CANTILEVER GATE SYSTEM</td>
<td>6</td>
</tr>
</tbody>
</table>
## Table of Contents

### Division 32 - Land Development

- **32 22 10** Erosion and Sediment Control  
- **32 31 10** Decorative Cantilever Gate System  
- **32 31 13** Chain Link Fences & Gates  
- **32 31 19** Decorative Fences & Gates  
- **32 91 13** Topsoiling  
- **32 91 15** Amended Planting Soil  
- **32 92 00** Lawn Turf and Grasses  
- **32 93 00** Planting  

### Division 33 - Utilities

- **33 25 10** Water Distribution  
- **33 41 00** Storm Drainage & Sanitary Sewer Piping  

**End of Table of Contents**
# SECTION 00 01 15 - LIST OF DRAWINGS

<table>
<thead>
<tr>
<th>SHEET NO.</th>
<th>TITLE</th>
<th>SHEET NO.</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-1</td>
<td>COVER SHEET</td>
<td>S102</td>
<td>MEZZANINE/LOW ROOF FRAMING PLAN</td>
</tr>
<tr>
<td>CS.1</td>
<td>ABBREVIATIONS, KEYNOTES, &amp; SYMBOLS</td>
<td>S103</td>
<td>ROOF FRAMING PLAN</td>
</tr>
<tr>
<td>CS.2</td>
<td>CODE STUDY &amp; EGRESS PLANS</td>
<td>S104</td>
<td>VESTIBULE ELEVATION</td>
</tr>
<tr>
<td>C-100</td>
<td>COVER SHEET</td>
<td>S501</td>
<td>TYPICAL FOUNDATION DETAILS</td>
</tr>
<tr>
<td>C-101</td>
<td>EXISTING CONDITIONS PLAN</td>
<td>S502</td>
<td>FOUNDATION SECTIONS AND DETAILS</td>
</tr>
<tr>
<td>C-102</td>
<td>PRECONSTRUCTION SITE STORMWATER &amp; SITE DEMO PLAN</td>
<td>S503</td>
<td>FOUNDATION SECTIONS AND DETAILS</td>
</tr>
<tr>
<td>C-103</td>
<td>POST-BULK E&amp;S CONTROL PLAN</td>
<td>S511</td>
<td>TYPICAL FOUNDATION DETAILS</td>
</tr>
<tr>
<td>C-104</td>
<td>SITE CONSTRUCTION E&amp;S CONTROL DETAILS AND NOTES</td>
<td>S512</td>
<td>FRAMING SECTIONS AND DETAILS</td>
</tr>
<tr>
<td>C-105</td>
<td>SITE CONSTRUCTION E&amp;S CONTROL DETAILS AND NOTES</td>
<td>S513</td>
<td>FRAMING SECTIONS AND DETAILS</td>
</tr>
<tr>
<td>C-106</td>
<td>GRADING &amp; DRAINAGE PLAN</td>
<td>S514</td>
<td>FRAMING SECTIONS AND DETAILS</td>
</tr>
<tr>
<td>C-107</td>
<td>SITE CONSTRUCTION UTILITIES PLAN</td>
<td>M01</td>
<td>MECHANICAL</td>
</tr>
<tr>
<td>C-108</td>
<td>SITE CONSTRUCTION UTILITIES PLAN</td>
<td>M1.1</td>
<td>FIRST AND SECOND FLOOR PLANS - HVAC</td>
</tr>
<tr>
<td>C-109</td>
<td>SITE CONSTRUCTION SIGNAGE, STRIPING, &amp; LAYOUT PLAN</td>
<td>M2.1</td>
<td>FIRST AND SECOND FLOOR PLANS - HVAC</td>
</tr>
<tr>
<td>C-110</td>
<td>SITE CONSTRUCTION DETAILS &amp; NOTES</td>
<td>M5.1</td>
<td>DETAILS AND DIAGRAMS</td>
</tr>
<tr>
<td>C-111</td>
<td>SITE CONSTRUCTION DETAILS &amp; NOTES</td>
<td>M5.2</td>
<td>DETAILS AND DIAGRAMS</td>
</tr>
<tr>
<td>C-112</td>
<td>SITE CONSTRUCTION DETAILS &amp; NOTES</td>
<td>M5.3</td>
<td>DETAILS AND DIAGRAMS</td>
</tr>
<tr>
<td>C-113</td>
<td>SITE CONSTRUCTION DETAILS &amp; NOTES</td>
<td>M5.4</td>
<td>DETAILS AND DIAGRAMS</td>
</tr>
<tr>
<td>LANDSCAPING</td>
<td></td>
<td>N8.1</td>
<td>SCHEDULES</td>
</tr>
<tr>
<td>L100</td>
<td>SITE REFERENCE &amp; TREE PROTECTION PLAN</td>
<td>N7.1</td>
<td>AUTOMATIC TEMPERATURE CONTROLS</td>
</tr>
<tr>
<td>L200</td>
<td>SITE LAYOUT AND GRADING PLAN</td>
<td>N7.2</td>
<td>AUTOMATIC TEMPERATURE CONTROLS</td>
</tr>
<tr>
<td>L201</td>
<td>SITE FENCING PLAN</td>
<td>N7.3</td>
<td>AUTOMATIC TEMPERATURE CONTROLS</td>
</tr>
<tr>
<td>L202</td>
<td>SERVICE AREA ENLARGEMENT PLAN</td>
<td>P1.1</td>
<td>FIRST AND SECOND FLOOR PLANS - PLUMBING</td>
</tr>
<tr>
<td>L203</td>
<td>SITE PLANTING PLAN</td>
<td>P1.2</td>
<td>FIRST AND SECOND FLOOR PLANS - PLUMBING</td>
</tr>
<tr>
<td>L301</td>
<td>SITE FENCING DETAILS</td>
<td>P1.3</td>
<td>DETAILS AND DIAGRAMS</td>
</tr>
<tr>
<td>L302</td>
<td>PLANTING NOTES &amp; DETAILS</td>
<td>P1.4</td>
<td>DETAILS AND DIAGRAMS</td>
</tr>
<tr>
<td>ARCHITECTURAL</td>
<td></td>
<td>P6.1</td>
<td>SCHEDULES</td>
</tr>
<tr>
<td>A1.1</td>
<td>ARCHITECTURAL SITE PLAN</td>
<td>P6.2</td>
<td>DETAILS AND DIAGRAMS</td>
</tr>
<tr>
<td>AC.2</td>
<td>CONSTRUCTION TYPES &amp; TYPICAL DETAILS</td>
<td>E01</td>
<td>SYMBOLS AND ABBREVIATIONS</td>
</tr>
<tr>
<td>A1.2</td>
<td>FLOOR PLANS &amp; FINISH SCHEDULE</td>
<td>E01.1</td>
<td>MEP SITE PLAN</td>
</tr>
<tr>
<td>A2.1</td>
<td>FLOOR &amp; ROOF PLANS</td>
<td>E01.2</td>
<td>MEP SITE PLAN</td>
</tr>
<tr>
<td>A3.1</td>
<td>REFLECTED CEILING DETAILS</td>
<td>E1.1</td>
<td>FIRST AND SECOND FLOOR PLANS - LIGHTING</td>
</tr>
<tr>
<td>A4.1</td>
<td>BUILDING SECTIONS</td>
<td>E1.2</td>
<td>FIRST AND SECOND FLOOR PLANS - POWER</td>
</tr>
<tr>
<td>A4.2</td>
<td>WALL SECTIONS</td>
<td>E1.3</td>
<td>FIRST AND SECOND FLOOR PLANS - SYSTEMS</td>
</tr>
<tr>
<td>A5.1</td>
<td>STAIR PLANS, SECTIONS, &amp; DETAILS</td>
<td>E5.0</td>
<td>ELEC. DETAILS &amp; DIAGRAMS</td>
</tr>
<tr>
<td>A6.1</td>
<td>PLAN DETAILS</td>
<td>E5.1</td>
<td>ELEC. DETAILS &amp; DIAGRAMS</td>
</tr>
<tr>
<td>A6.2</td>
<td>PLAN DETAILS</td>
<td>E5.2</td>
<td>ELEC. DETAILS &amp; DIAGRAMS</td>
</tr>
<tr>
<td>A6.3</td>
<td>SECTION DETAILS</td>
<td>E5.3</td>
<td>ELEC. DETAILS &amp; DIAGRAMS</td>
</tr>
<tr>
<td>A6.4</td>
<td>SECTION DETAILS</td>
<td>E5.4</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>A7.1</td>
<td>CASWORK DETAILS &amp; ACCESSORY SCHEDULE</td>
<td>E6.1</td>
<td>ELEC. DETAILS &amp; DIAGRAMS</td>
</tr>
<tr>
<td>A7.2</td>
<td>ENLARGED PLANS &amp; INTERIOR ELEVATIONS</td>
<td>E6.2</td>
<td>ELEC. DETAILS &amp; DIAGRAMS</td>
</tr>
<tr>
<td>A6.5</td>
<td>DOOR AND WINDOW SCHEDULES &amp; DETAILS</td>
<td>E6.3</td>
<td>ELEC. DETAILS &amp; DIAGRAMS</td>
</tr>
<tr>
<td>A6.6</td>
<td>SECTION DETAILS</td>
<td>E6.4</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>ANIMAL CAGING</td>
<td></td>
<td>E6.5</td>
<td>ELEC. DETAILS &amp; DIAGRAMS</td>
</tr>
<tr>
<td>CG-100</td>
<td>EXTERIOR HOLDING YARDS PLANS &amp; DETAILS</td>
<td>E6.6</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>CG-101</td>
<td>EXTERIOR HOLDING YARDS CAGING ELEVATIONS</td>
<td>E6.7</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>CG-200</td>
<td>SMALL ANIMAL HOLDING PLAN &amp; DETAILS</td>
<td>E6.8</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>CG-201</td>
<td>LARGE ANIMAL HOLDING PLAN &amp; DETAILS</td>
<td>E6.9</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>CG-202</td>
<td>MEDIUM ANIMAL HOLDING PLAN &amp; DETAILS</td>
<td>E6.10</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>CG-301</td>
<td>KEEPER DOOR ELEVATIONS &amp; DETAILS</td>
<td>E6.11</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>CG-301</td>
<td>ANIMAL DOOR ELEVATIONS &amp; SCHEDULES</td>
<td>E6.12</td>
<td>ELEC. SCHEDULES &amp; RISERS</td>
</tr>
<tr>
<td>STRUCTURAL</td>
<td></td>
<td>S01</td>
<td>COVER SHEET</td>
</tr>
<tr>
<td>S002</td>
<td>GENERAL NOTES</td>
<td>S002</td>
<td>GENERAL NOTES</td>
</tr>
<tr>
<td>S003</td>
<td>GENERAL NOTES</td>
<td>S003</td>
<td>GENERAL NOTES</td>
</tr>
<tr>
<td>S004</td>
<td>PROJECT SCHEDULES</td>
<td>S004</td>
<td>PROJECT SCHEDULES</td>
</tr>
<tr>
<td>S101</td>
<td>FOUNDATION PLAN</td>
<td>S101</td>
<td>FOUNDATION PLAN</td>
</tr>
</tbody>
</table>

---

LIST OF DRAWINGS 00 01 15 - 1

END OF SECTION 00 01 15
SECTION 00 11 16 – INVITATION TO BID

Sealed bids for Contract No. 2020-WBZ-100, QUARANTINE SUPPORT FACILITY will be received by the State of Delaware, DNREC, Division of Parks and Recreation on July 9, 2020 at 9:00 AM.

Sealed bids can be delivered in person following the State’s COVID precaution recommendations in force at that time or mailed, addressed to the Division of Parks and Recreation, Richardson and Robison Building, 89 Kings Highway, Dover, DE 19901. The outer envelope should clearly indicate: “DNREC CONTRACT NO. 2020-WBZ-100 – DNREC, DIVISION PARKS AND RECREATION QUARANTINE SUPPORT FACILITY SEALED BID - DO NOT OPEN.”

Bids will be accepted until 9:00 a.m. local time on Thursday July 9, 2020. Bids will be opened and read aloud at 10:00 a.m. local time on Thursday July 9, 2020. Bidders bear the risk of late delivery. Any bids received after the stated time whether by mail or in person will be rejected and the bids returned unopened. The bid opening will be held through electronic means to comply with the Governor’s State of Emergency. To attend the bid opening, the public may participate by joining the meeting at Webex.com, meeting number 717 928 874 call-in number 202-860-2110 or by video via 717928874@stateofdelaware.webex.com. There will be no in-person meeting. The project involves a new, two story quarantine support facility for the Brandywine Zoo located at 1001 North Park Drive, Wilmington, DE 19802. The building is two stories and approximately 4,134 SF housing a surgery, necropsy, lab, small animal holding, medium animal holding, large animal holding, restroom, shower, food prep area, office area and mechanical room. Exterior features are a medium animal yard and a large animal holding yard. Associated site improvements including, but not limited to, select demolition, new storm water, sanitary sewer and electric services. New paving, sidewalks, curbs, new fencing and landscaping are included in the scope of work.

A MANDATORY Pre-Bid Meeting will be held on Wednesday, June 24, 2020, at 9:00 a.m. at the Brandywine Zoo, 1001 North Park Drive, Wilmington, DE 19802 for the purpose of establishing the list of subcontractors and to answer questions. The meeting will be held near the Education Building on North Van Buren Street (Monkey Hill) across from the service entrance of the Zoo. Representatives of each party to any Joint Venture must attend this meeting. COVID distancing requirements in force at that time shall be strictly adhered to. ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT. Contract documents may be obtained by connecting with the smart sheet located at https://bit.ly/2TV Icelandic and filling in the required fields. Once the information is provided bid documents will be sent either by Dropbox or secure e-mail.

Bidders will not be subject to discrimination on the basis of race, creed, color, sex, sexual orientation, gender identity or national origin in consideration of this award, and Minority Business Enterprises, Disadvantaged Business Enterprises, Women-Owned Business Enterprises and Veteran-Owned Business Enterprises will be afforded full opportunity to submit bids on this contract. Each bid must be accompanied by a bid security equivalent to ten percent of the bid amount and all additive alternates. The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract. The Owner reserves the right to reject any or all bids and to waive any informalities therein.

Shawn M. Garvin, Cabinet Secretary

END OF SECTION 00 01 15
SECTION 00 21 13 - INSTRUCTIONS TO BIDDERS

TABLE OF ARTICLES

1. DEFINITIONS

2. BIDDER’S REPRESENTATION

3. BIDDING DOCUMENTS

4. BIDDING PROCEDURES

5. CONSIDERATION OF BIDS

6. POST-BID INFORMATION

7. PERFORMANCE BOND AND PAYMENT BOND

8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR
ARTICLE 1: GENERAL

1.1 DEFINITIONS

1.1.1 Whenever the following terms are used, their intent and meaning shall be interpreted as follows:

1.2 STATE: The State of Delaware.

1.3 AGENCY: Contracting State Agency as noted on cover sheet.

1.4 DESIGNATED OFFICIAL: The agent authorized to act for the Agency.

1.5 BIDDING DOCUMENTS: Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement for Bid, Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the Bid Form (including the Non-collusion Statement), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, as well as the Drawings, Specifications (Project Manual) and all Addenda issued prior to execution of the Contract.

1.6 CONTRACT DOCUMENTS: The Contract Documents consist of the, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the form of agreement between the Owner and the Contractor, Drawings (if any), Specifications (Project Manual), and all addenda.

1.7 AGREEMENT: The form of the Agreement shall be AIA Document A101, Standard Form of Agreement between Owner and Contractor where the basis of payment is a STIPULATED SUM. In the case of conflict between the instructions contained therein and the General Requirements herein, these General Requirements shall prevail.

1.8 GENERAL REQUIREMENTS (or CONDITIONS): General Requirements (or conditions) are instructions pertaining to the Bidding Documents and to contracts in general. They contain, in summary, requirements of laws of the State, policies of the Agency and instructions to bidders.

1.9 SPECIAL PROVISIONS: Special Provisions are specific conditions or requirements peculiar to the bidding documents and to the contract under consideration and are supplemental to the General Requirements. Should the Special Provisions conflict with the General Requirements, the Special Provisions shall prevail.

1.10 ADDENDA: Written or graphic instruments issued by the Owner/Architect prior to the execution of the contract which modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.

1.11 BIDDER OR VENDOR: A person or entity who formally submits a Bid for the material or Work contemplated, acting directly or through a duly authorized representative who meets the requirements set forth in the Bidding Documents.
1.12 SUB-BIDDER: A person or entity who submits a Bid to a Bidder for materials or labor, or both for a portion of the Work.

1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).

1.15 ALTERNATE BID (or ALTERNATE): An amount stated in the Bid, where applicable, to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents is accepted.

1.16 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

1.17 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.

1.18 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.

1.19 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.

1.20 CONTRACTOR: Any individual, firm, or corporation with whom a contract is made by the Agency.

1.21 SUBCONTRACTOR: An individual, partnership or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.

1.22 CONTRACT BOND: The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.
ARTICLE 2: BIDDER'S REPRESENTATIONS

2.1 PRE-BID MEETING

2.1.1 A pre-bid meeting for this project will be held at the time and place designated. Attendance at this meeting is a pre-requisite for submitting a Bid unless this requirement is specifically waived elsewhere in the Bid Documents.

2.2 By submitting a Bid, the Bidder represents that:

2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.

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

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

2.3 JOINT VENTURE REQUIREMENTS

2.3.1 For Public Works Contracts, each Joint Venturer shall be qualified and capable to complete the Work with their own forces.

2.3.2 Included with the Bid submission, and as a requirement to bid, a copy of the executed Joint Venture Agreement shall be submitted and signed by all Joint Venturers involved.

2.3.3 All required Bid Bonds, Performance Bonds, Material and Labor Payment Bonds must be executed by both Joint Venturers and be placed in both of their names.

2.3.4 All required insurance certificates shall name both Joint Venturers.

2.3.5 Both Joint Venturers shall sign the Bid Form and shall submit a copy of a valid Delaware Business License with their Bid.

2.3.6 Both Joint Venturers shall include their Federal E.I. Number with the Bid.

2.3.7 In the event of a mandatory Pre-bid Meeting, each Joint Venturer shall have a representative in attendance.

2.3.8 Due to exceptional circumstances and for good cause shown, one or more of these provisions may be waived at the discretion of the State.

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

2.4.1 As consideration for the award and execution by the Owner of this contract, the Contractor hereby grants, conveys, sells, assigns and transfers to the State of Delaware all of its right, title and interests in and to all known or unknown causes of action it presently has or may now or hereafter acquire under the antitrust laws of the United States and the State of Delaware.
Delaware, relating to the particular goods or services purchased or acquired by the Owner pursuant to this contract.

ARTICLE 3:  BIDDING DOCUMENTS

3.1  COPIES OF BID DOCUMENTS

3.1.1  Bidders may obtain complete sets of the Bidding Documents from the Architectural/Engineering firm designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein.

3.1.2  Bidders shall use complete sets of Bidding Documents for preparation of Bids. The issuing Agency nor the Architect assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3  Any errors, inconsistencies or omission discovered shall be reported to the Architect immediately.

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

3.2  INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

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

3.2.2  Bidders or Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Architect at least seven days prior to the date for receipt of Bids. Interpretations, corrections, and changes to the Bidding Documents will be made by written Addendum. Interpretations, corrections, or changes to the Bidding Documents made in any other manner shall not be binding.

3.2.3  The apparent silence of the specifications as to any detail, or the apparent omission from it of detailed description concerning any point, shall be regarded as meaning that only the best commercial practice is to prevail and only material and workmanship of the first quality are to be used. Proof of specification compliance will be the responsibility of the Bidder.

3.2.4  Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all permits, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.2.5  The Owner will bear the costs for all impact and user fees associated with the project.

3.3  SUBSTITUTIONS
3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of quality, required function, dimension, and appearance to be met by any proposed substitution. The specification of a particular manufacturer or model number is not intended to be proprietary in any way. Substitutions of products for those named will be considered, providing that the Vendor certifies that the function, quality, and performance characteristics of the material offered is equal or superior to that specified. It shall be the Bidder's responsibility to assure that the proposed substitution will not affect the intent of the design, and to make any installation modifications required to accommodate the substitution.

3.3.2 Requests for substitutions shall be made in writing to the Architect at least ten days prior to the date of the Bid Opening. Such requests shall include a complete description of the proposed substitution, drawings, performance and test data, explanation of required installation modifications due the substitution, and any other information necessary for an evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect’s decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.

3.3.3 If the Architect approves a substitution prior to the receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding.

3.3.4 The Architect shall have no obligation to consider any substitutions after the Contract award.

3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents.

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

3.4.3 No Addenda will be issued later than 4 days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of bids.

3.4.4 Each bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging an issued Addenda could be grounds for determining a bid to be non-responsive.

ARTICLE 4: BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.

4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the project manual for this purpose.
4.1.3 Execute all blanks on the Bid Form in a non-erasable medium (typewriter or manually in ink).

4.1.4 Where so indicated by the makeup of the Bid Form, express sums in both words and figures, in case of discrepancy between the two, the written amount shall govern.

4.1.5 Interlineations, alterations or erasures must be initialed by the signer of the Bid.

4.1.6 BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY. If there is no change in the Base Bid for an Alternate, enter “No Change”. The Contractor is responsible for verifying that they have received all addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract.

4.1.7 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.

4.1.8 Each copy of the Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached, certifying agent's authority to bind the Bidder.

4.1.9 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.

4.1.10 In the construction of all Public Works projects for the State of Delaware or any agency thereof, preference in employment of laborers, workers or mechanics shall be given to bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State.

4.1.11 Each bidder shall include in their bid a copy of a valid Delaware Business License.

4.1.12 Each bidder shall include a signed Affidavit for the Bidder certifying compliance with OMB Regulation 4104 - “Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on “Large Public Works Projects.” “Large Public Works” is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

4.2 BID SECURITY

4.2.1 All bids shall be accompanied by a deposit of either a good and sufficient bond to the agency for the benefit of the agency, with corporate surety authorized to do business in this State, the form of the bond and the surety to be approved by the agency, or a security of the bidder assigned to the agency, for a sum equal to at least 10% of the bid plus all add alternates, or in lieu of the bid bond a security deposit in the form of a certified check, bank treasurer’s check, cashier’s check, money order, or other prior approved secured deposit assigned to the State. The bid bond need not be for a specific sum, but may be stated to be for a sum equal to 10% of the bid plus all add alternates to which it relates and not to exceed a certain stated sum, if said sum is equal to at least 10% of the bid. The Bid Bond form used shall be the standard OMB form (attached).
4.2.2 The Agency has the right to retain the bid security of Bidders to whom an award is being considered until either a formal contract has been executed and bonds have been furnished or the specified time has elapsed so the Bids may be withdrawn or all Bids have been rejected.

4.2.3 In the event of any successful Bidder refusing or neglecting to execute a formal contract and bond within 20 days of the awarding of the contract, the bid bond or security deposited by the successful bidder shall be forfeited.

4.3 SUBCONTRACTOR LIST

4.3.1 As required by Delaware Code, Title 29, section 6962(d)(10)b, each Bidder shall submit with their Bid a completed List of Sub-Contractors included with the Bid Form. NAME ONLY ONE SUBCONTRACTOR FOR EACH TRADE. A Bid will be considered non-responsive unless the completed list is included.

4.3.2 Provide the Name and Address for each listed subcontractor. Addresses by City, Town, or Locality, plus State, will be acceptable.

4.3.3 It is the responsibility of the Contractor to ensure that their Subcontractors are in compliance with the provisions of this law. Also, if a Contractor elects to list themselves as a Subcontractor for any category, they must specifically name themselves on the Bid Form and able to document their capability to act as Subcontractor in that category in accordance with this law.

4.4 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

4.4.1 During the performance of this contract, the contractor agrees as follows:

A. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take affirmative action to ensure the applicants are employed, and that employees are treated during employment, without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

B. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, sex, color, sexual orientation, gender identity or national origin."

4.5 PREVAILING WAGE REQUIREMENT
4.5.1 Wage Provisions: For renovation and new construction projects whose costs exceed the thresholds contained in Delaware Code, Title 29, Section 6960, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

4.5.2 The employer shall pay all mechanics and labors employed directly upon the site of work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics.

4.5.3 The scale of the wages to be paid shall be posted by the employer in a prominent and easily accessible place at the site of the work.

4.5.4 Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

4.6 SUBMISSION OF BIDS

4.6.1 Enclose the Bid, the Bid Security, and any other documents required to be submitted with the Bid in a sealed opaque envelope. Address the envelope to the party receiving the Bids. Identify with the project name, project number, and the Bidder's name and address. If the Bid is sent by mail, enclose the sealed envelope in a separate mailing envelope with the notation "BID ENCLOSED" on the face thereof. The State is not responsible for the opening of bids prior to bid opening date and time that are not properly marked.

4.6.2 Deposit Bids at the designated location prior to the time and date for receipt of bids indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be marked “LATE BID” and returned.

4.6.3 Bidder assumes full responsibility for timely delivery at location designated for receipt of bids.

4.6.4 Oral, telephonic, or telegraphic bids are invalid and will not receive consideration.

4.6.5 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in compliance with these Instructions to Bidders.

4.7 MODIFICATION OR WITHDRAW OF BIDS

4.7.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax, if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.
4.7.2 Bidders submitting Bids that are late shall be notified as soon as practicable and the bid shall be returned.

4.7.3 A Bid may not be modified, withdrawn, or canceled by the Bidder during a thirty (30) day period following the time and date designated for the receipt and opening of Bids, and Bidder so agrees in submitting their Bid. Bids shall be binding for 30 days after the date of the Bid opening.

ARTICLE 5: CONSIDERATION OF BIDS

5.1 OPENING/REJECTION OF BIDS

5.1.1 Unless otherwise stated, Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.

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

5.1.3 If the Bids are rejected, it will be done within thirty (30) calendar day of the Bid opening.

5.2 COMPARISON OF BIDS

5.2.1 After the Bids have been opened and read, the bid prices will be compared, and the result of such comparisons will be made available to the public. Comparisons of the Bids may be based on the Base Bid plus desired Alternates. The Agency shall have the right to accept Alternates in any order or combination.

5.2.2 The Agency reserves the right to waive technicalities, to reject any or all Bids, or any portion thereof, to advertise for new Bids, to proceed to do the Work otherwise, or to abandon the Work, if in the judgment of the Agency or its agent(s), it is in the best interest of the State.

5.2.3 An increase or decrease in the quantity for any item is not sufficient grounds for an increase or decrease in the Unit Price.

5.2.4 The prices quoted are to be those for which the material will be furnished F.O.B. Job Site and include all charges that may be imposed during the period of the Contract.

5.2.5 No qualifying letter or statements in or attached to the Bid, or separate discounts will be considered in determining the low Bid except as may be otherwise herein noted. Cash or separate discounts should be computed and incorporated into Unit Bid Price(s).

5.3 DISQUALIFICATION OF BIDDERS

5.3.1 An agency shall determine that each Bidder on any Public Works Contract is responsible before awarding the Contract. Factors to be considered in determining the responsibility of a Bidder include:

A. The Bidder’s financial, physical, personnel or other resources including Subcontracts.
B. The Bidder’s record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of the Prevailing Wage Laws in Delaware or any other state.

C. The Bidder’s written safety plan.

D. Whether the Bidder is qualified legally to contract with the State.

E. Whether the Bidder supplied all necessary information concerning its responsibility; and,

F. Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the Invitation to Bid and is otherwise in conformity with State and/or Federal law.

5.3.2 If an agency determines that a Bidder is nonresponsive and/or nonresponsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within five (5) working days of said determination.

5.3.3 In addition, any one or more of the following causes may be considered as sufficient for the disqualification of a Bidder and the rejection of their Bid or Bids.

5.3.3.1 More than one Bid for the same Contract from an individual, firm or corporation under the same or different names.

5.3.3.2 Evidence of collusion among Bidders.

5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

5.3.3.4 If the Unit Prices are obviously unbalanced either in excess or below reasonable cost analysis values.

5.3.3.5 If there are any unauthorized additions, interlineation, conditional or alternate bids or irregularities of any kind which may tend to make the Bid incomplete, indefinite or ambiguous as to its meaning.

5.3.3.6 If the Bid is not accompanied by the required Bid Security and other data required by the Bidding Documents.

5.3.3.7 If any exceptions or qualifications of the Bid are noted on the Bid Form.

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

5.4.1 A formal Contract shall be executed with the successful Bidder within twenty (20) calendar days after the award of the Contract.
5.4.2 Per Section 6962(d)(13) a., Title 29, Delaware Code, “The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid.”

5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.

5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.

5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. The successful Bidder shall provide, at least two business days prior to contract execution, copies of the Employee Drug Testing Program for the Bidder and all listed Subcontractors. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the contract. Bonds shall remain in effect for period of one year after the date of substantial completion.

5.4.6 If the successful Bidder fails to execute the required Contract, Bond and all required information, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or advertised, as the Agency may decide.

5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and a copy of its Delaware business license, and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION
6.1 CONTRACTOR’S QUALIFICATION STATEMENT

6.1.1 Bidders to whom award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor’s Qualification Statement, unless such a statement has been previously required and submitted.

6.2 BUSINESS DESIGNATION FORM

6.2.1 Successful bidder shall be required to accurately complete an Office of Management and Budget Business Designation Form for Subcontractors.

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

7.1.1 The cost of furnishing the required Bonds, that are stipulated in the Bidding Documents, shall be included in the Bid.

7.1.2 If the Bidder is required by the Agency to secure a bond from other than the Bidder’s usual sources, changes in cost will be adjusted as provide in the Contract Documents.

7.1.3 The Performance and Payment Bond forms used shall be the standard OMB forms (attached).

7.2 TIME OF DELIVERY AND FORM OF BONDS

7.2.1 The bonds shall be dated on or after the date of the Contract.

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

ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR

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

END OF INSTRUCTIONS TO BIDDERS
QUARANTINE SUPPORT BUILDING
BRANDYWINE ZOO
1001 N PARK DRIVE, WILMINGTON, DELAWARE 19802
DIVISION OF PARKS AND RECREATION CONTRACT No. 2020-WBZ-100

BID FORM

For Bids Due: Thursday, July 9, 2020 @ 9:00 am
To: Dept. of Natural Resources and Environmental Control
Division of Parks and Recreation
Office of Design and Development
89 Kings Highway, Dover DE 19901

Name of Bidder: ________________________________

Delaware Business License No.: ________________ Taxpayer ID No.: ________________
(A copy of Bidder’s Delaware Business License must be attached to this form.)

(Other License Nos.): ________________________________

Phone Number: ( ) _______ _______ Fax Number: ( ) _______ _______

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

$ ____________

($ ____ )

Rock Removal Allowance: 50 CY x Unit Price $__________/Unit of Measure = $__________/Amount

Dewatering Allowance $_________ $25,000

Total Bid: $ ____________

($ ____ )
BID FORM

ALTERNATES

Alternate prices conform to applicable project specification section. Refer to specifications for a complete description of the following Alternates. An “ADD” or “DEDUCT” amount is indicated by the crossed-out part that does not apply.

ALTERNATE No. 1: Caging Material

1. In lieu of galvanized caging change to stainless steel caging in medium and large animal rooms numbers: 101A, 101B, 101C, 103A, 103B, 110, and 111.
2. Base Bid includes galvanized caging material in the rooms listed above.

Add/Deduct:

($ )

No. of Days to Complete Alternate 1: 

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications 01 22 00 – Unit Prices for a complete description of the following Unit Prices:

<table>
<thead>
<tr>
<th>UNIT PRICE No.</th>
<th>Item Description</th>
<th>DEDUCT</th>
<th>ADD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Concrete Paving</td>
<td>$ ____________</td>
<td>$ ____________</td>
</tr>
<tr>
<td>2</td>
<td>Asphalt Paving</td>
<td>$ ____________</td>
<td>$ ____________</td>
</tr>
<tr>
<td>3</td>
<td>Unsatisfactory Soil</td>
<td>$ ____________</td>
<td>$ ____________</td>
</tr>
<tr>
<td>4</td>
<td>Unsatisfactory Soil at Walkways</td>
<td>$ ____________</td>
<td>$ ____________</td>
</tr>
<tr>
<td>5</td>
<td>Landscape Boulders</td>
<td>$ ____________</td>
<td>$ ____________</td>
</tr>
<tr>
<td>6</td>
<td>Excavation of Rock/Boulders</td>
<td>$ ____________</td>
<td>$ ____________</td>
</tr>
</tbody>
</table>
QUARANTINE SUPPORT BUILDING
BRANDYWINE ZOO
1001 N PARK DRIVE, WILMINGTON, DELAWARE 19802
DIVISION OF PARKS AND RECREATION CONTRACT No. 2020-WBZ-100

BID FORM

I/We acknowledge Addendums numbered ______________________ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for thirty (30) days from the date of opening of bids, and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within ________ calendar days of the Notice to Proceed.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By ___________________________________________ Trading as ___________________________________________

(State of Corporation)

Business Address: __________________________________________

Witness: ________________________________ By: ________________________________

(Authorized Signature)

(Seal)

(Title)

Date: ________________________________

ATACHMENTS
Sub-Contractor List
Non-Collusion Statement
Affidavit of Employee Drug Testing Program
Bid Security
(Others as Required by Project Manual)
In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, the following subcontractor listing must accompany any bid submittal. The bidder must list in each category the full name and address (City & State) of the sub-contractor that the bidder will be using to perform the work and provide material for that subcontractor category. Should the bidder’s listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the bidder shall list that third-tier contractor’s full name and address (City & State). If the bidder intends to perform any category of work itself, it must list its full name and address. For clarification, if the bidder intends to perform the work themselves, the bidder may not insert “not applicable”, “N/A”, “self” or anything other than its own full name and address (City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (*) next to any additional third tier contractors and submit it with your bid.

<table>
<thead>
<tr>
<th>Subcontractor Category</th>
<th>Subcontractor</th>
<th>Address (City &amp; State)</th>
<th>Subcontractors taxpayer ID # or Delaware Business license #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sitework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Paving</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Hardscape</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Landscape</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BID FORM
<table>
<thead>
<tr>
<th>Section</th>
<th>A.</th>
<th>B.</th>
<th>C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Masonry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Doors, Frames, &amp; Hardware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Painting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Concrete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Roofing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Mechanical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Plumbing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Electric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Site Utilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Caging</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
15. Fencing

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
BID FORM

NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date to the Office of Design and Development, Division of Parks and Recreation, DNREC.

All the terms and conditions of the Quarantine Support Building have been thoroughly examined and are understood.

NAME OF BIDDER

__________________________________________

AUTHORIZED REPRESENTATIVE (TYPED):

__________________________________________

AUTHORIZED REPRESENTATIVE (SIGNATURE):

__________________________________________

TITLE:

__________________________________________

ADDRESS OF BIDDER:

__________________________________________

__________________________________________

E-MAIL:

__________________________________________

PHONE NUMBER:

__________________________________________

Sworn to and Subscribed before me this ________________ day of ________________ of 20___________.

My commission expires ______________________. NOTARY PUBLIC ________________

THIS PAGE MUST BE SIGNED AND NOTORIZED FOR YOUR BID TO BE CONSIDERED.
AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite, including subcontractors that complies with this regulation:

Contractor/Subcontractor Name: ________________________________

Contractor/Subcontractor Address: ________________________________

Authorized Representative (typed or printed): ________________________________

Authorized Representative (signature): ________________________________

Title: ________________________________

Sworn to and Subscribed before me this ______ day of _______ 20____.

My Commission expires _______________. NOTARY PUBLIC ____________________

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.
STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: ________________ of ____________, in the County of ____________, and State of ____________, as Principal, and ________________, in the County of ____________, and State of ____________, as Surety, legally authorized to do business in the State of Delaware (“State”), are held and firmly unto the State in the sum of ________________, Dollars ($ ________________), or ________________ percent not to exceed ________________ Dollars ($ ________________), of amount of bid on Contract No. 2020-WBZ-100, to be paid to the State for the use and benefit of (Department of Natural Resources and Environmental Control) for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bonded Principal who has submitted to the (Department of Natural Resources and Environmental Control) a certain proposal to enter into this contract for the furnishing of certain material and/or services within the State, shall be awarded this Contract, and if said Principal shall well and truly enter into and execute this Contract as may be required by the terms of this Contract and approved by the (Department of Natural Resources and Environmental Control) this Contract to be entered into within twenty days after the date of official notice of the award thereof, in accordance with the terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

Sealed with ____________ seal and dated this ____________ day of ____________ in the year of our Lord two thousand and ____________ (20 ____) .

SEALED, AND DELIVERED IN THE
Presence of

________________________________________________________
Name of Bidder (Organization)

Corporate Seal

By: ____________________________________________________________________________
Authorized Signature

Attest ____________________________________________________________________________

Title

________________________________________________________
Name of Surety

Witness: __________________________________________________________________________

By: ____________________________________________________________________________

Title

BID BOND 00 43 13
THIS PAGE INTENTIONALLY LEFT BLANK
STATE OF DELAWARE

DIVISION OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

AIA 101-2017 AGREEMENT BETWEEN OWNER AND CONTRACTOR
AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

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

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

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

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

The Owner and Contractor agree as follows.

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

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

The parties should complete A101™—2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™—2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.
TABLE OF ARTICLES
1 THE CONTRACT DOCUMENTS
2 THE WORK OF THIS CONTRACT
3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
4 CONTRACT SUM
5 PAYMENTS
6 DISPUTE RESOLUTION
7 TERMINATION OR SUSPENSION
8 MISCELLANEOUS PROVISIONS
9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS
The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT
The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
   (Insert a date or a means to determine the date of commencement of the Work.)

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

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

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

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

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

[ ] By the following date:

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

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

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

ARTICLE 4 CONTRACT SUM
§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor’s performance of the Contract. The Contract Sum shall be ($ ), subject to additions and deductions as provided in the Contract Documents.

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

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

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

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

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

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

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

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

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

§ 4.6 Other: (Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)
ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

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

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

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

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

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

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

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

.1 That portion of the Contract Sum properly allocable to completed Work;
.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
.3 That portion of Construction Change Directives that the Architect determines, in the Architect’s professional judgment, to be reasonably justified.

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

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

§ 5.1.7 Retainage

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

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)
§ 5.1.7.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

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

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

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

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

§ 5.2 Final Payment
§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when
.1 the Contractor has fully performed the Contract except for such portions thereof as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
.2 a final Certificate for Payment has been issued by the Architect.

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

§ 5.3 Interest
Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

%  

ARTICLE 6 DISPUTE RESOLUTION
§ 6.1 Initial Decision Maker
The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)
§ 6.2 Binding Dispute Resolution
For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the
method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[ ] Litigation in a court of competent jurisdiction

[ ] Other (Specify)

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

ARTICLE 7 TERMINATION OR SUSPENSION
§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document
A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner’s convenience in accordance with Article 14 of AIA Document
A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination
for the Owner’s convenience.)

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

ARTICLE 8 MISCELLANEOUS PROVISIONS
§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract
Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract
Documents.

§ 8.2 The Owner’s representative:
(Name, address, email address, and other information)

§ 8.3 The Contractor’s representative:
(Name, address, email address, and other information)
§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

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

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

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS
§ 9.1 This Agreement is comprised of the following documents:
  .1 AIA Document A101™-2017, Standard Form of Agreement Between Owner and Contractor
  .2 AIA Document A101™-2017, Exhibit A, Insurance and Bonds
  .3 AIA Document A201™-2017, General Conditions of the Contract for Construction
  .4 AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
    (Insert the date of the E203-2013 incorporated into this Agreement.)

  .5 Drawings

      Number     Title     Date

  .6 Specifications

      Section     Title     Date     Pages

  .7 Addenda, if any:

      Number     Date     Pages

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

  .8 Other Exhibits:
    (Check all boxes that apply and include appropriate information identifying the exhibit where required.)
AIA Document E204™-2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

[ ] The Sustainability Plan:

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>Pages</th>
</tr>
</thead>
</table>

[ ] Supplementary and other Conditions of the Contract:

<table>
<thead>
<tr>
<th>Document</th>
<th>Title</th>
<th>Date</th>
<th>Pages</th>
</tr>
</thead>
</table>

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

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

<table>
<thead>
<tr>
<th>OWNER (Signature)</th>
<th>CONTRACTOR (Signature)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Printed name and title)</td>
<td>(Printed name and title)</td>
</tr>
</tbody>
</table>
Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the day of _ in the year
(In words, indicate day, month and year.)

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

THE OWNER:
(Name, legal status and address)

THE CONTRACTOR:
(Name, legal status and address)

TABLE OF ARTICLES

A.1 GENERAL
A.2 OWNER'S INSURANCE
A.3 CONTRACTOR'S INSURANCE AND BONDS
A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL
The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201™-2017, General Conditions of the Contract for Construction.

ARTICLE A.2 OWNER'S INSURANCE
§ A.2.1 General
Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor’s request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

§ A.2.2 Liability Insurance
The Owner shall be responsible for purchasing and maintaining the Owner’s usual general liability insurance.

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

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

This document is intended to be used in conjunction with AIA Document A201™-2017, General Conditions of the Contract for Construction. Article 11 of A201™-2017 contains additional insurance provisions.
§ A.2.3 Required Property Insurance
§ A.2.3.1 Unless this obligation is placed on the Contractor pursuant to Section A.3.3.2.1, the Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder’s risk “all-risk” completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner’s property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.2.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

§ A.2.3.1.1 Causes of Loss. The insurance required by this Section A.2.3.1 shall provide coverage for direct physical loss or damage, and shall not exclude the risks of fire, explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuring loss or resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials. Sub-limits, if any, are as follows:
(Indicate below the cause of loss and any applicable sub-limit.)

<table>
<thead>
<tr>
<th>Causes of Loss</th>
<th>Sub-Limit</th>
</tr>
</thead>
</table>

§ A.2.3.1.2 Specific Required Coverages. The insurance required by this Section A.2.3.1 shall provide coverage for loss or damage to falsework and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect’s and Contractor’s services and expenses required as a result of such insured loss, including claims preparation expenses. Sub-limits, if any, are as follows:
(Indicate below type of coverage and any applicable sub-limit for specific required coverages.)

<table>
<thead>
<tr>
<th>Coverage</th>
<th>Sub-Limit</th>
</tr>
</thead>
</table>

§ A.2.3.1.3 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section A.2.3.1 or, if necessary, replace the insurance policy required under Section A.2.3.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 12.2.2 of the General Conditions.

§ A.2.3.1.4 Deductibles and Self-Insured Retentions. If the insurance required by this Section A.2.3 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

§ A.2.3.2 Occupancy or Use Prior to Substantial Completion. The Owner’s occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.2.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.

§ A.2.3.3 Insurance for Existing Structures
If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, “all-risk” property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage from the causes of loss identified in Section A.2.3.1, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

§ A.2.4 Optional Extended Property Insurance.
The Owner shall purchase and maintain the insurance selected and described below.
(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to

Init. / 

AIA Document A101™ – 2017 Exhibit A. Copyright © 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 09:54:07 ET on 08/15/2019 under Order No. 3280045935 which expires on 01/28/2020, and is not for resale.

User Notes:
the description(s) of selected insurance. For each type of insurance selected, indicate applicable limits of coverage or other conditions in the fill point below the selected item.)

[ ] § A.2.4.1 Loss of Use, Business Interruption, and Delay in Completion Insurance, to reimburse the Owner for loss of use of the Owner’s property, or the inability to conduct normal operations due to a covered cause of loss.

[ ] § A.2.4.2 Ordinance or Law Insurance, for the reasonable and necessary costs to satisfy the minimum requirements of the enforcement of any law or ordinance regulating the demolition, construction, repair, replacement or use of the Project.

[ ] § A.2.4.3 Expediting Cost Insurance, for the reasonable and necessary costs for the temporary repair of damage to insured property, and to expedite the permanent repair or replacement of the damaged property.

[ ] § A.2.4.4 Extra Expense Insurance, to provide reimbursement of the reasonable and necessary excess costs incurred during the period of restoration or repair of the damaged property that are over and above the total costs that would normally have been incurred during the same period of time had no loss or damage occurred.

[ ] § A.2.4.5 Civil Authority Insurance, for losses or costs arising from an order of a civil authority prohibiting access to the Project, provided such order is the direct result of physical damage covered under the required property insurance.

[ ] § A.2.4.6 Ingress/Egress Insurance, for loss due to the necessary interruption of the insured’s business due to physical prevention of ingress to, or egress from, the Project as a direct result of physical damage.

[ ] § A.2.4.7 Soft Costs Insurance, to reimburse the Owner for costs due to the delay of completion of the Work, arising out of physical loss or damage covered by the required property insurance: including construction loan fees; leasing and marketing expenses; additional fees, including those of architects, engineers, consultants, attorneys and accountants, needed for the completion of the construction, repairs, or reconstruction; and carrying costs such as property taxes, building permits, additional interest on loans, realty taxes, and insurance premiums over and above normal expenses.

§ A.2.5 Other Optional Insurance.
The Owner shall purchase and maintain the insurance selected below.
(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance.)

[ ] § A.2.5.1 Cyber Security Insurance for loss to the Owner due to data security and privacy breach, including costs of investigating a potential or actual breach of confidential or private information. (Indicate applicable limits of coverage or other conditions in the fill point below.)
§ A.2.5.2 Other Insurance
(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

Coverage Limits

ARTICLE A.3 CONTRACTOR’S INSURANCE AND BONDS
§ A.3.1 General
§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner’s written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor’s Commercial General Liability and excess or umbrella liability policy or policies.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect, and the Architect’s consultants as additional insureds for claims caused in whole or in part by the Contractor’s negligent acts or omissions during the Contractor’s operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor’s negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner’s general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect’s consultants, CG 20 32 07 04.

§ A.3.2 Contractor’s Required Insurance Coverage
§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.2.2 Commercial General Liability
§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than ($ ) each occurrence, ($ ) general aggregate, and ($ ) aggregate for products-completed operations hazard, providing coverage for claims including:
.1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
.2 personal injury and advertising injury;
.3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
.4 bodily injury or property damage arising out of completed operations; and
.5 the Contractor’s indemnity obligations under Section 3.18 of the General Conditions.

§ A.3.2.2.2 The Contractor’s Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

Init. 1

AIA Document A101™ – 2017 Exhibit A. Copyright © 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 09:54:07 ET on 09/15/2019 under Order No. 6268465S5 which expires on 01/25/2020, and is not for resale.

User Notes:

(389ADA55)
.1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.

.2 Claims for property damage to the Contractor’s Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.

.3 Claims for bodily injury other than to employees of the insured.

.4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.

.5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.

.6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.

.7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.

.8 Claims related to roofing, if the Work involves roofing.

.9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.

.10 Claims related to earth subsidence or movement, where the Work involves such hazards.

.11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than ($) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ A.3.2.5 Workers’ Compensation at statutory limits.

§ A.3.2.6 Employers’ Liability with policy limits not less than ($) each accident, ($) each employee, and ($) policy limit.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers’ Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks.

§ A.3.2.8 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.9 If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.10 Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.11 Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.12 Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

AIA Document A101™ – 2017 Exhibit A. Copyright © 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 08:54:07 ET on 06/15/2019 under Order No. 3260645935 which expires on 01/25/2020, and is not for resale.

User Notes:
§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.

(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

[ ] § A.3.3.2.1 Property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below. (Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

[ ] § A.3.3.2.2 Railroad Protective Liability Insurance, with policy limits of not less than ($ ) per claim and ($ ) in the aggregate, for Work within fifty (50) feet of railroad property.

[ ] § A.3.3.2.3 Asbestos Abatement Liability Insurance, with policy limits of not less than ($ ) per claim and ($ ) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

[ ] § A.3.3.2.4 Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

[ ] § A.3.3.2.5 Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

[ ] § A.3.3.2.6 Other Insurance

(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage Limits

§ A.3.4 Performance Bond and Payment Bond

The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:

(Specify type and penal sum of bonds.)

Init. /
Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement.

**ARTICLE A.4 SPECIAL TERMS AND CONDITIONS**
Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:
SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017

The following supplements modify the “Standard Form of Agreement Between Owner and Contractor,” AIA Document A101-2017. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE 3: DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

3.1 Delete paragraph 3.1 in its entirety and replace with the following:

“The date of Commencement of the Work shall be a date set forth in a notice to proceed issued by the Owner.”

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

5.1.3 Delete paragraph 5.1.3 in its entirety and replace with the following:

“Provided that a valid Application for Payment is received by the Architect that meets all requirements of the Contract, payment shall be made by the Owner not later than 30 days after the Owner receives the valid Application for Payment.”

5.3 Insert the interest rate of “1% per month not to exceed 12% per annum.”

ARTICLE 6: DISPUTE RESOLUTION

6.2 BINDING DISPUTE RESOLUTION

Check Other – and add the following sentence:

"Any remedies available in law or in equity."

ARTICLE 7: TERMINATION or SUSPENSION

7.1.1 Delete paragraph 7.1.1 in its entirety.

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.4 Delete paragraph 8.4 in its entirety and replace with the following:

“The Contractor’s representative shall not be changed without ten days written notice to the Owner.”

END OF SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR

SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2007
SUPPLEMENT TO A101-2017 – EXHIBIT ‘A’ INSURANCE AND BONDS

The following supplements modify the “Standard Form of Agreement Between Owner and Contractor,” AIA Document A101-2017 Exhibit A Insurance and Bonds. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE A.2 OWNER’S INSURANCE

A.2.1 General
Delete paragraph A.2.1 in its entirety.

A.2.2 Liability Insurance
Delete paragraph A.2.2 in its entirety, except in the case of school projects this paragraph shall remain.

A.2.3 Required Property Insurance
Delete paragraph A.2.3 in its entirety.

A.2.4 Optional Extended Property Insurance
Delete paragraph A.2.4 in its entirety.

A.2.5 Other Optional Insurance
Delete paragraph A.2.5 in its entirety.

ARTICLE A.3 CONTRACTORS INSURANCE AND BONDS

A.3.1.3 Additional Insured Obligations
In the first sentence after “coverage to include (1)” delete “(1) the Owner,”.

Strike the remainder of the first sentence beginning at the semicolon “; and (2) the Owner” through the end of the sentence.

Delete the second sentence in its entirety.

A.3.3.2.1 Delete paragraph 3.3.2.1 in its entirety and replace with the following:
Property Insurance of the same type and scope satisfying the requirements identified in Section A.2.3, The Contractor shall comply with all obligations of the Owner under A.2.3 except to the extent provided below. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required.

END SUPPLEMENT TO A101-2017 – EXHIBIT A INSURANCE AND BONDS
STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

PERFORMANCE BOND

Bond Number: ___________________

KNOW ALL PERSONS BY THESE PRESENTS, that we, ______________________, as principal ("Principal"), and ______________________, a ______________________ corporation, legally authorized to do business in the State of Delaware, as surety ("Surety"), are held and firmly bound unto the __________________________________ ("Owner") (Department of Natural Resources and Environmental Control), in the amount of ______________________ ($___________), to be paid to Owner, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this __________ day of ____________, 20__. 

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if Principal, who has been awarded by Owner that certain contract known as Contract No. 2020-WBZ-100 dated the __________ day of ____________, 20__ (the “Contract”), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse Owner sufficient funds to pay the costs of completing the Contract that Owner may sustain by reason of any failure or default on the part of Principal, and shall also indemnify and save harmless Owner from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, hereby stipulates and agrees, if requested to do so by Owner, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause Principal fails or neglects to so fully perform and complete such work.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of Surety and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and Surety hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to Surety as though done or omitted to be done by or in relation to Principal.

Surety hereby stipulates and agrees that no modifications, omissions, or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of Surety and its bond.
Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to Surety or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, Principal and Surety have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: __________________________________________
Witness or Attest: Address: __________________________

__________________________ By: ___________________________(SEAL)
Name: ________________________
Title: _________________________

(Corporate Seal)

SURETY

Name: __________________________________________
Witness or Attest: Address: __________________________

__________________________ By: ___________________________(SEAL)
Name: ________________________
Title: _________________________

(Corporate Seal)
KNOW ALL PERSONS BY THESE PRESENTS, that we, ____________________, as principal ("Principal"), and __________________, a ____________________ corporation, legally authorized to do business in the State of Delaware, as surety ("Surety") are held and firmly bound unto the ____________________ ("Owner") (Department of Natural Resources and Environmental Control), in the amount of _________________ ($___________), to be paid to Owner, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this _____________ day of____________, 20__. 

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if Principal, who has been awarded by Owner that certain contract known as Contract No. ___ 2020-WBZ-100 dated the __________ day of _____________, 20__, (the “Contract”), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which Principal is liable, shall make good and reimburse Owner sufficient funds to pay such costs in the completion of the Contract as Owner may sustain by reason of any failure or default on the part of Principal, and shall also indemnify and save harmless Owner from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of Surety and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and Surety hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to Surety as though done or omitted to be done by or in relation to Principal.

Surety hereby stipulates and agrees that no modifications, omission, or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of Surety and its bond.
Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to Surety or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, Principal and Surety have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: ______________________________

Witness or Attest: Address: ______________________________

_____________________________ By: ______________________________(SEAL)
Name: ______________________________
Name: ______________________________
Title: ______________________________

(Corporate Seal)

SURETY

Name: ______________________________

Witness or Attest: Address: ______________________________

_____________________________ By: ______________________________(SEAL)
Name: ______________________________
Name: ______________________________
Title: ______________________________

(Corporate Seal)
Application and Certificate for Payment

TO OWNER: PROJECT: 

FROM CONTRACTOR: VIA ARCHITECT: 
Bernardon Haber Holloway Architects PC Three Mill Road, Suite 211 Wilmington, Delaware 19806

APPLICATION NO: 001
PERIOD TO: CONTRACT FOR: General Construction
CONTRACT DATE: PROJECT NOS: 

CONTRACTOR'S APPLICATION FOR PAYMENT

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR: 
By: 
Date: ______________

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED $ 0.00

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT: 
By: 
Date: ______________

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.
## Continuation Sheet

AIA Document G703™ – 1992

AIA Document G702. APPLICATION AND CERTIFICATION FOR PAYMENT, containing Contractor's signed certification is attached.

In tabulations below, amounts are stated to the nearest dollar.

Use Column I on Contracts where variable retainage for line items may apply.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITEM NO.</td>
<td>DESCRIPTION OF WORK</td>
<td>SCHEDULED VALUE</td>
<td>WORK COMPLETED FROM PREVIOUS APPLICATION (D+E)</td>
<td>THIS PERIOD</td>
<td>MATERIALS PRESENTLY STORED (NOT IN D OR E)</td>
<td>TOTAL COMPLETED AND STORED TO DATE (D+E+F)</td>
<td>% (G-C)</td>
<td>BALANCE TO FINISH (C - G)</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td></td>
<td>$ 0.00</td>
<td>$ 0.00</td>
<td>$ 0.00</td>
<td>$ 0.00</td>
<td>0.00 %</td>
<td>$ 0.00</td>
<td>$ 0.00</td>
</tr>
</tbody>
</table>
STATE OF DELAWARE
DIVISION OF FACILITIES MANAGEMENT

GENERAL CONDITIONS

TO THE

CONTRACT

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (2017 Edition) entitled General Conditions of the Contract for Construction as revised by the Supplementary General Conditions and is part of this project manual as therein written in full.
AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

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

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

TABLE OF ARTICLES

1  GENERAL PROVISIONS
2  OWNER
3  CONTRACTOR
4  ARCHITECT
5  SUBCONTRACTORS
6  CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
7  CHANGES IN THE WORK
8  TIME
9  PAYMENTS AND COMPLETION
10 PROTECTION OF PERSONS AND PROPERTY
11 INSURANCE AND BONDS
12 UNCOVERING AND CORRECTION OF WORK
13 MISCELLANEOUS PROVISIONS
14 TERMINATION OR SUSPENSION OF THE CONTRACT
15 CLAIMS AND DISPUTES

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

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

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.
INDEX
(Topics and numbers in bold are Section headings.)

Acceptance of Nonconforming Work
9.6.6, 9.9.3, 12.3
Acceptance of Work
9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, 12.3
Access to Work
3.16, 6.2.1, 12.1
Accident Prevention
10
Acts and Omissions
3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5,
10.2.8, 13.3.2, 14.1, 15.1.2, 15.2
Addenda
1.1.1
Additional Costs, Claims for
3.7.4, 3.7.5, 10.3.2, 15.1.5
Additional Inspections and Testing
9.4.2, 9.8.3, 12.2.1, 13.4
Additional Time, Claims for
3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, 15.1.6
Administration of the Contract
3.1.3, 4.2, 9.4, 9.5
Advertisement or Invitation to Bid
1.1.1
Aesthetic Effect
4.2.13
Allowances
3.8
Applications for Payment
4.2.5, 7.3.9, 9.2, 9.3, 9.4, 9.5.1, 9.5.4, 9.6.3, 9.7, 9.10
Approvals
2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9,
3.12.10.1, 4.2.7, 9.3.2, 13.4.1
Arbitration
8.3.1, 15.3.2, 15.4
ARCHITECT
4
Architect, Definition of
4.1.1
Architect, Extent of Authority
2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2,
9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1,
13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.4.1, 15.2.1
Architect, Limitations of Authority and
Responsibility
2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2,
4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4,
9.4.2, 9.5.4, 9.6.4, 15.1.4, 15.2
Architect’s Additional Services and Expenses
2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4
Architect’s Administration of the Contract
3.1.3, 3.7.4, 15.2, 9.4.1, 9.5
Architect’s Approvals
2.5, 3.1.3, 3.5, 3.10.2, 4.2.7
Architect’s Authority to Reject Work
3.5, 4.2.6, 12.1.2, 12.2.1
Architect’s Copyright
1.1.7, 1.5
Architect’s Decisions
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3,
7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1,
13.4.2, 15.2
Architect’s Inspections
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4
Architect’s Instructions
3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2
Architect’s Interpretations
4.2.11, 4.2.12
Architect’s Project Representative
4.2.10
Architect’s Relationship with Contractor
1.1.2, 1.5, 9.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2,
3.5, 7.3.4, 7.3.7, 7.3.9, 7.9.2, 7.9.3, 7.10, 3.1.1, 3.12, 1.16,
3.18, 4.2.1, 4.2.5, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4.9, 9.5,
7.9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2
Architect’s Relationship with Subcontractors
1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3
Architect’s Representations
9.4.2, 9.5.1, 9.10.1
Architect’s Site Visits
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Asbestos
10.3.1
Attorneys’ Fees
3.18.1, 9.6.8, 9.10.2, 10.3.3
Award of Separate Contracts
6.1.1, 6.1.2
Award of Subcontracts and Other Contracts for
Portions of the Work
5.2
Basic Definitions
1.1
Bidding Requirements
1.1.1
Bidding Dispute Resolution
8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5,
15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1
Bonds, Lien
7.3.4.4, 9.6.8, 9.10.2, 9.10.3
Bonds, Performance, and Payment
7.3.4.4, 9.6.7, 9.10.3, 11.1.2, 11.1.3, 11.5
Building Information Models Use and Reliance
1.8
Building Permit
3.7.1
Capitalization
1.3
Certificate of Substantial Completion
9.8.3, 9.8.4, 9.8.5

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 09:57:10 ET on 08/15/2019 under Order No. 3260845935 which expires on 01/26/2020, and is not for resale.

User Notes:
Certificates for Payment
4.2.1, 4.2.5, 4.2.9, 9.3.3, 8.4, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4
Certificates of Inspection, Testing or Approval
13.4.4
Certificates of Insurance
9-10.2
Change Orders
1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, 7.2, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2
Change Orders, Definition of
7.2.1
CHANGES IN THE WORK
2.2.2, 3.11, 4.2.8, 7, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.5
Claims, Definition of
15.1.1
Claims, Notice of
1.6.2, 15.1.3
CLAIMS AND DISPUTES
3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, 15, 15.4
Claims and Timely Assertion of Claims
15.4.1
Claims for Additional Cost
3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, 15.7.5
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, 15.7.5
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, 10.3.2, 10.3.3, 11.3, 11.3.2, 14.2.4, 15.1.7
Claims Subject to Arbitration
15.4.1
Cleaning Up
3.15, 6.3
Commencement of the Work, Conditions Relating to
2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, 15.1.5
Commencement of the Work, Definition of
8.1.2
Communications
3.9.1, 4.2.4
Completion, Conditions Relating to
3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 14.1.2, 15.1.2
COMPLETION, PAYMENTS AND
9
Completion, Substantial
3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 15.1.2
Compliance with Laws
2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3
Concealed or Unknown Conditions
3.7.4, 4.2.8, 8.3.1, 10.3
Conditions of the Contract
1.1.1, 6.1.1, 6.1.4
Consent, Written
3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2, 15.4.4.2
Consolidation or Joiner
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, 3.12.3, 3.12.2, 6.1.3, 15.1.6.2
Contractor's Assignment of Subcontracts
5.6, 14.2.2.2
Contracting, Contract Performance
1.1.4
Contract, Definition of
1.1.2
CONTRACT, TERMINATION OR SUSPENSION
OF THE
5.4.1.1, 5.4.2, 11.5, 14
Contract Administration
3.1.3, 4.9.4, 9.5
Contract Award and Execution, Conditions Relating to
3.7.1, 3.10, 5.2, 6.1
Contract Documents, Copies Furnished and Use of
1.5.2, 2.3.6, 5.3
Contract Documents, Definition of
1.1.1
Contract Sum
2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4, 9.1, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2, 12.3, 14.2.4, 14.3.2, 15.1.4.2, 15.1.5, 15.2.5
Contract Sum, Definition of
9.1
Contract Time
1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5, 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1, 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2, 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5
Contract Time, Definition of
8.1.1
CONTRACTOR
3
Contractor, Definition of
3.1, 6.1.2
Contractor's Construction and Submittal Schedules
3.10, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2
Contractor's Employees
2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.3, 14.1, 14.2.1.1
Contractor's Liability Insurance
11.1
Contractor's Relationship with Separate Contractors and Owner's Forces
3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4
Contractor's Relationship with Subcontractors
1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7, 9.10.2, 11.2, 11.3, 11.4
Contractor's Relationship with the Architect
1.1.2, 1.5, 2.3.3, 3.13, 3.2.2, 3.2.3, 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, 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
3.14.2, 6.2.5
Damage to Construction of Owner or Separate Contractors
3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damages, Claims for
3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2, 11.3, 14.2.4, 15.1.7
Damages for Delay
6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2
Date of Commencement of the Work, Definition of
8.1.2
Date of Substantial Completion, Definition of
8.1.3
Day, Definition of
8.1.4
Decisions of the Architect
3.7.4, 4.2.6, 4.2.7, 4.2.12, 4.2.13, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 8.9.4, 8.9.5, 9.5.1, 9.8.4, 9.9.1, 13.4.2, 14.2.2, 14.2.4, 15.1.5, 15.2
Decisions to Withhold Certification
9.4.1, 9.5, 9.7, 9.11.1.3
Defective or Nonconforming Work, Acceptance, Rejection and Correction of
2.6, 3.7.4, 6.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3, 10.4, 12.2.1
Definitions
1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1
Delays and Extensions of Time
3.2, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4.3, 8.3, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5
Digital Data Use and Transmission
1.7
Disputes
6.3, 7.3.9, 15.1, 15.2
Documents and Samples at the Site
3.11
Drawings, Definition of
1.1.5
Drawings and Specifications, Use and Ownership of
3.11
Effective Date of Insurance
8.2.2
Emergencies
10.4, 14.1.1.2, 15.1.5
Employees, Contractor's
3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.3, 14.1, 14.2.1.1
Equipment, Labor, or Materials
1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Execution and Progress of the Work
1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1, 9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4
Extensions of Time
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.4, 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
GENERAL PROVISIONS
1
Governing Law
13.1
Guarantees (See Warranty)
Hazardous Materials and Substances
10.2.4, 10.3
Identification of Subcontractors and Suppliers
5.2.1
Indemnification
3.17, 3.18, 9.6.8, 9.10.2, 10.3.3, 11.3
Information and Services Required of the Owner
2.1.2, 2.2, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5,
9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2,
14.1.1.4, 14.1.4, 15.1.4
Initial Decision
15.2
Initial Decision Maker, Definition of
11.8
Initial Decision Maker, Decisions
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Initial Decision Maker, Extent of Authority
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Injury or Damage to Person or Property
10.2.8, 10.4
Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,
9.9.2, 9.10.1, 12.2.1, 13.4
Instructions to Bidders
1.1.1
Instructions to the Contractor
3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2
Instruments of Service, Definition of
11.1.7
Insurance
6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5,
11
Insurance, Notice of Cancellation or Expiration
11.1.4, 11.2.3
Insurance, Contractor’s Liability
11.1
Insurance, Effective Date of
8.2.2, 14.4.2
Insurance, Owner’s Liability
11.2
Insurance, Property
10.2.5, 11.2, 11.4, 11.5
Insurance, Stored Materials
9.3.2
INSURANCE AND BONDS
11
Insurance Companies, Consent to Partial Occupancy
9.9.1
Insured loss, Adjustment and Settlement of
11.5
Intent of the Contract Documents
12.1.1, 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, 3.1, 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,
10.2.4, 14.2.1.1, 14.2.1.2
Labor, Disputes
8.4
Laws and Regulations
1.2, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4,
9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8,
15.4
Liens
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Limitations, Statutes of
12.2.5, 15.1.2, 15.4.1.1
Limitations of Liability
3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6,
4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3,
11.3, 12.2.5, 13.3.1
Limitations of Time
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7,
5.2.3, 5.4.1, 6.2.4, 7.3.4, 8.2, 9.2, 9.3.1, 9.3.3,
9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15,
15.1.2, 15.1.3, 15.1.5
Materials, Hazardous
10.2.4, 10.3
Materials, Labor, Equipment and
1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,
5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2,
10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2
Means, Methods, Techniques, Sequences and
Procedures of Construction
3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2
Mechanic’s Lien
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Mediation
8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, 15.3, 15.4.1,
15.4.1.1
Minor Changes in the Work
1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, 7.4
MISCELLANEOUS PROVISIONS
13
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

1.11, 1.16, 1.17, 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, 5.9, 9.2, 9.3, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.2, 14.2.4, 14.4.3
Payment, Certificates for

2.5, 4.2.9, 9.3.3, 9.4, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4
Payment, Failure of

9.5.1.3, 9.7, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Payment, Final

4.2.1, 4.2.9, 9.10, 12.3, 14.2.4, 14.4.3
Payment Bond, Performance Bond and

7.3.4.4, 9.6.7, 9.10.3, 11.1.2
Payments, Progress

9.3, 9.6, 9.8.5, 9.10.3, 14.2.3, 15.1.4
PAYMENTS AND COMPLETION

9
Payments to Subcontractors

5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2
PCB

10.3.1
Performance Bond and Payment Bond

7.3.4.4, 9.6.7, 9.10.3, 11.1.2
Permits, Fees, Notices and Compliance with Laws

2.3.1, 3.7, 3.13, 7.3.4.4, 10.2.2
PERSONS AND PROPERTY, PROTECTION OF

10
Polychlorinated Biphenyl

10.3.1
Product Data, Definition of

3.12.2
Product Data and Samples, Shop Drawings

3.11, 3.12, 4.2.7
Progress and Completion

4.2.2, 8.2, 9.8, 9.9.1, 14.1.4, 15.1.4
Progress Payments

9.3, 9.6, 9.8.5, 9.10.3, 14.2.3, 15.1.4
Project, Definition of

1.1.4
Project Representatives

...
4.2.10
Property Insurance
10.2.5, 11.2
Proposal Requirements
1.1.1
PROTECTION OF PERSONS AND PROPERTY
10
Regulations and Laws
15.2, 15.4, 15.4, 15.5, 15.6, 15.7, 3.12.10, 3.13, 3.13.4, 3.13.9, 3.13.10, 10.2.10, 10.2.3, 10.2.4, 13.1, 13.3, 13.5, 13.6, 13.8, 15.2, 15.4
Rejection of Work
4.2.6, 12.2.1
Releases and Waivers of Liens
9.3.1, 9.10.2
Representations
3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1
Representatives
2.1.1, 3.1.1, 3.1.2, 4.2.1, 4.2.10, 13.1.1
Responsibility for Those Performing the Work
3.3.2, 3.3.3, 3.4.2, 3.4.3, 3.5, 6.1, 6.3, 6.4, 9.3.1, 10
Retention
9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3
Review of Contract Documents and Field Conditions
by Contractor
3.2, 3.12.7, 6.1.3
Review of Contractor’s Submittals by Owner and
Architect
3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1, 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, 3.8, 3.12.5, 4.2.6, 5.3, 6.6.1,
1.3, 6.3, 6.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2,
12.2, 13.3, 14.5.4
Royalties, Patents and Copyrights
3.17
Rules and Notices for Arbitration
15.4.1
Safety of Persons and Property
10.2, 10.4
Safety Precautions and Programs
3.3.1, 4.2.2, 4.2.7, 5.3, 10.1, 10.2, 10.4
Samples, Definition of
3.12.3
Samples, Shop Drawings, Product Data and
3.11, 3.12, 4.2.7
Samples at the Site, Documents and
3.11
Schedule of Values
9.2, 9.3.1
Schedules, Construction
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Separate Contracts and Contractors
1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2
Separate Contractors, Definition of
6.1.1
Shop Drawings, Definition of
3.12.1
Shop Drawings, Product Data and Samples
3.11, 3.12.4, 4.2.7
Site, Use of
3.13, 3.14.1, 4.2.1
Site Inspections
3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.2, 9.4.2, 9.10.1, 13.4
Site Visits, Architect’s
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Special Inspections and Testing
4.2.6, 12.2.1, 13.4
Specifications, Definition of
1.1.6
Specifications
1.1.1, 1.1.6, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14
Statute of Limitations
15.1.2, 15.4.1
Stoppage of Work
3.2.2, 3.4, 3.7, 10.3, 14.1
Supplied Materials
3.3.1, 3.4.3, 12.1.2, 10.2.4
Subcontractor, Definition of
5.1.1
SUBCONTRACTORS
5
Subcontractors, Work by
3.1.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4,
9.3.1, 9.6.7
Subcontractual Relations
5.3, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1
Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3,
9.8, 9.9.1, 9.10.2, 9.10.3
Submittal Schedule
3.10.2, 3.12.5, 4.2.7
Subrogation, Waivers of
6.1.1, 11.3
Substances, Hazardous
10.3
Substantial Completion
4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3,
12.2.1, 15.1.2
Substantial Completion, Definition of
9.8.1
Substitution of Subcontractors
5.2.3, 5.2.4
Substitution of Architect
2.3.3
Substitutions of Materials
3.4.2, 3.5, 7.3.8
Sub-contractor, Definition of
5.1.2
Subsurface Conditions
3.7.4
Successors and Assigns

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 09:57:10 ET on 08/15/2019 under order No.
3200345935 which expires on 01/25/2020, and is not for resale.
13.2
Superintendent
3.9, 10.2.6
Supervision and Construction Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4,
7.1.3, 7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4
Suppliers
1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6,
9.10.5, 14.2.1
Surety
5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2,
15.2.7
Surety, Consent of
9.8.5, 9.10.2, 9.10.3
Surveys
1.1.7, 2.3.4
Suspension by the Owner for Convenience
14.3
Suspension of the Work
3.7.5, 5.4.2, 14.3
Suspension or Termination of the Contract
5.4.1.1, 14
Taxes
3.6, 3.8.2.1, 7.3.4.4
Termination by the Contractor
14.1, 15.1.7
Termination by the Owner for Cause
5.4.1.1, 14.2, 15.1.7
Termination by the Owner for Convenience
14.4
Termination of the Architect
2.3.3
Termination of the Contractor Employment
14.2.2

TERMINATION OR SUSPENSION OF THE
CONTRACT
14
Tests and Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,
9.9.2, 9.10.1, 10.3.2, 12.2.1, 13.4
TIME
8
Time, Delays and Extensions of
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, 8.3, 9.5.1, 9.7,
10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5
Time Limits
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2,
5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3,
9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14,
15.1.2, 15.1.3, 15.4
time Limits on claims
3.7.4, 10.2.8, 15.1.2, 15.1.3
title to work
9.3.2, 9.3.3
UNCOVERING AND CORRECTION OF WORK
12
Uncovering of Work
12.1
Unforeseen Conditions, Concealed or Unknown
3.7.4, 8.3.1, 10.3
Unit Prices
7.3.3.2, 9.1.2
Use of Documents
1.1.1, 1.5, 2.3.5, 3.2.6, 5.3
Use of Site
3.13, 6.1.1, 12.1
Value, Schedule of
9.3, 9.3.1
Waiver of Claims by the Architect
13.3.2
Waiver of Claims by the Contractor
9.10.5, 13.3.2, 15.1.7
Waiver of Claims by the Owner
9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, 15.1.7
Waiver of Consequential Damages
14.2.4, 15.1.7
Waiver of Liens
9.3, 9.10.2, 9.10.4
Waivers of Subrogation
6.1.1, 11.3
Warranty
3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2,
15.1.2
Weather Delays
8.3, 15.1.6.2
Work, Definition of
1.1.3
Written Consent
1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3,
13.2, 13.3.2, 15.4.4.2
Written Interpretations
4.2.11, 4.2.12
Written Orders
1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

Init. / f

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 06:57:10 ET on 08/15/2019 under Order No. 3200845935 which expires on 09/25/2020, and is not for resale.

User Notes:

(389ADAS58)
ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

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

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

§ 1.1.3 The Work
The term “Work” means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all 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 or part of the Work performed under the Contract Documents may be the whole or a part which may include construction by the Owner and by Separate Contractors.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 1.7 Digital Data Use and Transmission
The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.
§ 1.8 Building Information Models Use and Reliance
Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™-2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER
§ 2.1 General
§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term “Owner” means the Owner or the Owner's authorized representative.

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

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

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

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

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

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

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

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

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

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

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

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

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

ARTICLE 3 CONTRACTOR
§ 3.1 General
§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term “Contractor” means the Contractor or the Contractor’s authorized representative.

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

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

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

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

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

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

§ 3.3 Supervision and Construction Procedures

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

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

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

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.
§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

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

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

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

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

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

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

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

§ 3.7.4 Concealed or Unknown Conditions
If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor’s cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect’s determination or recommendation, that party may submit a Claim as provided in Article 15.
§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.
§ 3.16 Access to Work
The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

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

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

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

ARTICLE 4 ARCHITECT
§ 4.1 General
§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ARTICLE 5 SUBCONTRACTORS
§ 5.1 Definitions
§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term “Subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term “Subcontractor” does not include a Separate Contractor or the subcontractors of a Separate Contractor.

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

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

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

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

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

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

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

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

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

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
§ 6.1 Owner’s Right to Perform Construction and to Award Separate Contracts
§ 6.1.1 The term “Separate Contractor(s)” shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner’s own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

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

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

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

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

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

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

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

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

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

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

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

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

§ 7.2 Change Orders
§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:
  .1 The change in the Work;
  .2 The amount of the adjustment, if any, in the Contract Sum; and
  .3 The extent of the adjustment, if any, in the Contract Time.

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

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

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

Init.

AIA Document A201™ – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 09:57:10 ET on 08/15/2019 under Order No. 3260845935 which expires on 01/26/2020, and is not for resale.

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

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:
.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers’ compensation insurance, and other employee costs approved by the Architect;
.2 Costs of materials, supplies, and equipment, including costs of transportation, whether incorporated or consumed;
.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
.4 Costs of premiums for all bonds and insurance, permits, fees, and sales, use, or similar taxes, directly related to the change; and
.5 Costs of supervision and field office personnel directly attributable to the change.

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

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

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

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

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

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

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

ARTICLE 8 TIME
§ 8.1 Definitions
§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

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

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

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

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

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

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

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

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

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

ARTICLE 9 PAYMENTS AND COMPLETION
§ 9.1 Contract Sum
§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 9.6 Progress Payments

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

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

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

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor’s payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.
§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

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

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

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

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

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

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

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

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

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

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

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

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

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.
§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from
   .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
   .2 failure of the Work to comply with the requirements of the Contract Documents;
   .3 terms of special warranties required by the Contract Documents; or
   .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

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

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY
§ 10.1 Safety Precautions and Programs
   The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs
   in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property
§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to
   prevent damage, injury, or loss to
   .1 employees on the Work and other persons who may be affected thereby;
   .2 the Work and materials and equipment to be incorporated therein, whether in storage 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, carry, and maintain, as required by existing conditions and performance of
   the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings
   against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of
   the safeguards.

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

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

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

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or
   create an unsafe condition.
§ 10.2.8 Injury or Damage to Person or Property
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

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

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

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

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

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

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

§ 10.4 Emergencies
In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor’s discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.
ARTICLE 11 INSURANCE AND BONDS
§ 11.1 Contractor’s Insurance and Bonds
§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect’s consultants shall be named as additional insureds under the Contractor’s commercial general liability policy or as otherwise described in the Contract Documents.

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

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

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

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

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

§ 11.2.3 Notice of Cancellation or Expiration of Owner’s Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.
§ 11.3 Waivers of Subrogation
§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect’s consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceed of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect’s consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

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

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance
The Owner, at the Owner’s option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner’s property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner’s property, due to fire or other hazards however caused.

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK
§ 12.1 Uncovering of Work
§ 12.1.1 If a portion of the Work is covered contrary to the Architect’s request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect’s examination and be replaced at the Contractor’s expense without change in the Contract Time.

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

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

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

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

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

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

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

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

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

ARTICLE 13 MISCELLANEOUS PROVISIONS
§ 13.1 Governing Law
The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction’s choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.
§ 13.2 Successors and Assigns
§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

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

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

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

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

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

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

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

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

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

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

AIA Document A201™ – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1956, 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 09:07:10 ET on 08/15/2019 under Order No. 2260845935 which expires on 01/25/2020, and is not for resale.
ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;

.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

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

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

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

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

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

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

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

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

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

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

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

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent
   .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
   .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience
§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner’s convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner’s convenience, the Contractor shall
   .1 cease operations as directed by the Owner in the notice;
   .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
   .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

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

ARTICLE 15 CLAIMS AND DISPUTES
§ 15.1 Claims
§ 15.1.1 Definition
A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term “Claim” also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

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

§ 15.1.3 Notice of Claims
§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.
§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

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

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

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

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

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

§ 15.1.7 Waiver of Claims for Consequential Damages
The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes:
.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

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

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

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

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

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

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

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

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

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

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

§ 15.3 Mediation

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

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

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute within 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.
§ 15.3.4 The parties shall share the mediator’s fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

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

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

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

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

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

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required for complete relief 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.
SUPPLEMENTARY GENERAL CONDITIONS A201-2017

The following supplements modify the “General Conditions of the Contract for Construction,” AIA Document A201-2007. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
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
ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

Strike the last sentence of Section 1.1.1 in its entirety and replace with the following:

“The Contract Documents also include Advertisement for Bid, Instructions to Bidder, sample forms, the Bid Form, the Contractor’s completed Bid and the Award Letter.”

Add the following Section:

1.1.1.1 In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Division of Facilities Management shall take precedence over all other documents.”

1.1.8 INITIAL DECISION MAKER

Strike the last sentence of Section 1.1.8 in its entirety and add the following to the end of the remaining sentence:

“and certify termination of the Agreement under Section 14.2.2.”

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

1.2.1.1 Insert “if possible” at the end of the second sentence.

Add the following Sections:

1.2.4 In the case of an inconsistency between the Drawings and the Specifications, or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect’s interpretation.”

1.2.5 The word “PROVIDE” as used in the Contract Documents shall mean “FURNISH AND INSTALL” and shall include, without limitation, all labor, materials, equipment, transportation, services and other items required to complete the Work.”

1.2.6 The word “PRODUCT” as used in the Contract Documents means all materials, systems and equipment.”

1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

Strike Section 1.5.1 in its entirety and replace with the following:
“All pre-design studies, drawings, specifications and other documents, including those in electronic form, prepared by the Architect under this Agreement are, and shall remain, the property of the Owner whether the Project for which they are made is executed or not. Such documents may be used by the Owner to construct one or more like Projects without the approval of, or additional compensation to, the Architect. The Contractor, Subcontractors, Sub-subcontractors, and Material or Equipment Suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect’s consultants appropriate to and for use in the execution of their Work under the Contract Documents. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or Material and Equipment Supplier on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and Architect’s consultants.

The Architect shall not be liable for injury or damage resulting from the re-use of drawings and specifications if the Architect is not involved in the re-use Project. Prior to re-use of construction documents for a Project in which the Architect is not also involved, the Owner will remove from such documents all identification of the original Architect, including name, address and professional seal or stamp.”

Strike Section 1.5.2 in its entirety.

1.7 DIGITAL DATA USE AND TRANSMISSION

Strike Section 1.7 in its entirety and replace with the following:

“The parties shall agree upon protocols governing transmission and use of Instruments of Service or any other information or documentation in digital form.”

1.8 BUILDING INFORMATION MODELS USE AND RELIANCE

Strike Section 1.8 in its entirety.

ARTICLE 2: OWNER

2.2 EVIDENCE OF THE OWNERS FINANCIAL ARRANGEMENTS

Strike Section 2.2 in its entirety.

2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.3.3 Strike 2.3.3 in its entirety.

2.3.4 Add the following sentence at the end of the paragraph:

“The Contractor, at their expense shall bear the costs to accurately identify the location of all underground utilities in the area of their excavation and shall bear all cost for any repairs required, out of failure to accurately identify said utilities.”

Strike Section 2.3.6 in its entirety and replace with the following:
2.3.6 The Contractor shall be furnished free of charge (1) electronic set of the Drawings and Project Manuals. Additional sets will be furnished at the cost of reproduction, postage and handling.

2.5 OWNER’S RIGHT TO CARRY OUT THE WORK

Add “, except as outlined in Section 3.15” after the reference to “Article 15” at the end of the last sentence of the Section.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.2.2 Add “and Owner” after “report to the Architect” in the second sentence.

3.2.4 Strike “subject to Section 15.1.7” in the second sentence.

3.2.4 Strike the third sentence.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Sections:

“3.3.2.1 The Contractor shall immediately remove from the Work, whenever requested to do so by the Owner, any person who is considered by the Owner or Architect to be incompetent or disposed to be so disorderly, or who for any reason is not satisfactory to the Owner, and that person shall not again be employed on the Work without the consent of the Owner or the Architect.”

“3.3.4 The Contractor must provide suitable storage facilities at the Site for the proper protection and safe storage of their materials, or as otherwise identified by the specifications. Consult the Owner and the Architect before storing any materials.”

“3.3.5 When any room is used as a shop, storeroom, office, etc., by the Contractor or Subcontractor(s) during the construction of the Work, the Contractor making use of these areas will be held responsible for any repairs, patching or cleaning arising from such use.”

3.4 LABOR AND MATERIALS

Add the Following Sections:

“3.4.4 Before starting the Work, each Contractor shall carefully examine all preparatory Work that has been executed to receive their Work. Check carefully, by whatever means are required, to ensure that its Work and adjacent, related Work, will finish to
proper contours, planes, and levels. Promptly notify the Architect & Owner of any defects or imperfections in preparatory Work which will in any way affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects will not be recognized.”

“3.4.5 Under no circumstances shall the Contractor’s Work proceed prior to preparatory Work having been completely cured, dried and/or otherwise made satisfactory to receive this Work. Responsibility for timely installation of all materials rests solely with the Contractor responsible for that Work, who shall maintain coordination at all times.”

3.5 WARRANTY

Add the following Sections:

“3.5.3 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for two years after Acceptance by the Owner, and will maintain all items in perfect condition during the period of warranty.”

“3.5.4 Defects appearing during the period of warranty will be made good by the Contractor at his expense upon demand of the Owner, it being required that all work will be in perfect condition when the period of warranty will have elapsed.”

“3.5.5 Upon notification by the Owner of a defect covered by the Contractor’s warranty, the Contractor shall respond within 4 hours of the notification.”

“3.5.6 In addition to the General Warranty there are other warranties required for certain items for different periods of time than the two years as above and are particularly so stated in that part of the specifications referring to same. The said warranties will commence at the same time as the General Warranty.”

“3.5.7 If the Contractor fails to remedy any failure, defect or damage within a reasonable time after receipt of notice, the Owner will have the right to replace, repair, or otherwise remedy the failure, defect or damage at the Contractor’s expense.”

3.8 ALLOWANCES

Add the following Section:

“3.8.1.1 For costs to be covered under a project allowance, (included in the schedule of values) the Contractor shall submit a summary of those costs anticipated and an Allowance Access Authorization Form to the Architect and Owner, reflecting the projected costs. The Allowance Access Authorization Form must be signed by the Owner prior to initiating any work associated with the allowance.”

3.10 CONTRACTOR’S CONSTRUCTION AND SUBMITTAL SCHEDULES

3.10.1 Add “estimated” after “and the” and before “date of” in the second sentence.
3.10.2 Strike “and thereafter as necessary to maintain a current submittal schedule” in the first sentence.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Sections:

“3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations.”

“3.11.2 At the completion of the project, the Contractor shall obtain a set of the conformed contract drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions.”

“3.11.3 Upon completion of the work noted in 3.11.2 the contractor shall schedule a meeting with the Architect/Engineer and Owner to review the final record drawings and closeout documents prior to submission. After this meeting, the Contractor shall make adjustments per the review and submit one (1) original markup and (2) copies of the red line drawings (as-built conditions, to the Owner and one (1) print to the Architect. In addition, attach one complete set of the as-built documents to each of the Operating and Maintenance Instructions/Manuals. The Contractor will include (2) USB drives, each containing all “red line drawings (as-built) and Closeout Documents properly tabbed in accordance with closeout requirements as defined elsewhere in the contract documents.”

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.10.2 Strike “If the Contract Documents require” from the beginning of the sentence.

3.12.10.2 Strike “to” between “professional” and certify” and replace with “shall”.

3.17 Insert “indemnify and” between “shall” and “hold” in the second sentence.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ADMINISTRATION OF THE CONTRACT

4.2.7 Strike the first sentence and replace with the following:

“The Architect will review and approve or take other appropriate action upon the Contractor’s submittals such as Shop Drawings, Product Data and Samples for the purpose of checking for conformance with the Contract Documents.”

4.2.7 Strike the second sentence and replace with the following:
“The Architect’s action will be taken with such reasonable promptness as to cause no delay in the Work in the activities of the Owner, Contractor or separate Contractors, while allowing sufficient time in the Owner’s professional judgment to permit adequate review.”

Add the following Section:

“4.2.10.1 There will be no full-time Project Representative provided by the Owner or Architect on this project.”

“4.2.13 Add “and in compliance with all local requirements,” to the end of the sentence.”

ARTICLE 5: SUBCONTRACTORS

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

5.2.3 Strike Section 5.2.3 in its entirety and replace with the following:

“If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection, subject to the statutory requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4.”

5.2.4 Strike Section 5.2.4 in its entirety and replace with the following:

”The Contractor may not substitute any Subcontractor listed in its Bid unless the Contractor complies with the requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4. Failure to comply with this requirement shall subject the Contractor to a penalty as outlined in Section 5.2 of the Owner’s General Requirements.”

Add the following Section:

“5.2.5 The Contractor shall comply and shall ensure all Subcontractors comply with all requirements for drug testing as set forth in TITLE 19 LABOR DELAWARE ADMINISTRATIVE CODE 4000 Office of Management and Budget 4100 Division of Facilities Management 4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects.”

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 Strike “and waiver of subrogation” from the end of the second sentence.

6.1.4 Strike Section 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY
6.2.3 Strike “shall” and replace with “may” in the second sentence.

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK IN THE STATE OF DELAWARE DIVISION OF FACILITIES MANAGEMENT GENERAL REQUIREMENTS)

7.3.4.1 Strike “and other employee costs approved by the Architect” after “worker’s compensation insurance,”

7.3.4.4 Add “work attributable to the” before “change” at the end of the sentence.

7.4 MINOR CHANGES IN WORK
Add “unless such changes are approved” at the end of the third sentence.

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

8.2.1 Add the following Section:

“8.2.1.1 Refer to Project Specifications Section SUMMARY OF WORK for Contract time requirements.”

8.2.2 After “by the Contractor” strike “and” and insert “to”.

8.2.4 Add the following Section:

“8.2.4 If the Work falls behind the Progress Schedule as submitted by the Contractor, the Contractor shall employ additional labor and/or equipment necessary to bring the Work into compliance with the Progress Schedule at no additional cost to the Owner.”

8.3 DELAYS AND EXTENSION OF TIME

8.3.1 Strike “binding dispute resolution” and insert “any and all remedies at law or in equity”.

Add the following Section:

“8.3.2.1 The Contractor shall update the status of the suspension, delay, or interruption of the Work with each Application for Payment. (The Contractor shall report the termination of such cause immediately upon the termination thereof.) Failure to comply with this procedure shall constitute a waiver for any claim for adjustment of time or price based upon said cause.”

Strike Section 8.3.3 in its entirety and replace with the following:
8.3.3 “Except in the case of a suspension of the Work directed by the Owner, an extension of time under the provisions of Section 8.3.1 shall be the Contractor’s sole remedy in the progress of the Work and there shall be no payment or compensation to the Contractor for any expense or damage resulting from the delay.”

Add the following Section:

“8.3.4 By permitting the Contractor to work after the expired time for completion of the project, the Owner does not waive their rights under the Contract.”

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Sections:

“9.2.1 The Schedule of Values shall be submitted using AIA Document G703, Continuation Sheet to G702.”

“9.2.2 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 1.5% of the initial contract amount.”

9.3 APPLICATIONS FOR PAYMENT

9.3.1 Strike Section 9.3.1 in its entirety and replace with the following:

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

Add the following Sections:

“9.3.1.3 Application for Payment shall be submitted on AIA Document G702 “Application and Certificate for Payment”, supported by AIA Document G703 “Continuation Sheet”. Said Applications shall be fully executed and notarized.”

“9.3.4 Until Closeout Documents have been received and outstanding items completed the Owner will pay 95% (ninety-five percent) of the amount due the Contractor on account of progress payments.”

“9.3.5 The Contractor shall provide a current and updated Progress Schedule to the Architect with each Application for Payment. Failure to provide Schedule will be just cause for rejection of Application for Payment.”
9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following Subsections to 9.5.1:

.8 failure to provide a current Progress Schedule.
.9 a lien or attachment is filed.
.10 failure to comply with mandatory requirements for maintaining Record Documents.

9.6 PROGRESS PAYMENTS

9.6.1 Strike Section 9.6.1 in its entirety and replace with the following:

“9.6.1 After the Architect has approved and issued a Certificate for Payment, payment shall be made by the Owner within 30 days after Owner’s receipt of the Certificate for Payment.”

9.6.8 Strike “Provided the Owner has fulfilled its payment obligations under the Contract Documents,” in the first sentence.

9.7 FAILURE OF PAYMENT

Strike Section 9.7 in its entirety and replace with the following:

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

9.8 SUBSTANTIAL COMPLETION

9.8.3 At the end of Section 9.8.3, add the following sentence:

“If the Architect is required to make more than 2 inspections of the same portion of work, the Contractor shall be responsible for all costs associated with subsequent inspections including but not limited to any Architect’s fees.”

9.8.5 Strike “shall” and insert “may” in the second sentence.

9.8.5 Insert “1/2 of the” after “make payment of” in the second sentence.
9.9 PARTIAL OCCUPANCY OR USE

9.9.1 Strike the first sentence and replace with the following (the remainder of the Section remains as written):
“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 authorized by public authorities having jurisdiction over the Project.”

9.10.2 Strike “to remain in force after final payment is currently in effect” after “required by the Contract Documents” and replace with “shall remain in force until final payment is completed” in the first sentence.

9.10.4.4 Strike “if permitted by the Contract Documents,”

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Sections:

10.1.1 Each Contractor shall develop a safety program in accordance with the Occupational Safety and Health Act of 1970. A copy of said plan shall be furnished to the Owner and Architect prior to the commencement of that Contractor’s Work.

10.1.2 Each Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full-time basis. If deemed necessary by the Owner or Architect, Contractor Safety meetings will be scheduled. The attendance of all Safety Representatives will be required. Minutes will be recorded of said meetings by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Section:

10.2.4.1 As required in the Hazardous Chemical Act of June 1984, all vendors supplying any material that may be defined as hazardous must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a caution warning on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in foreseeable emergency situations. Material Safety Data Sheets shall be provided directly to the Owner, along with the shipping slips that include those products.

10.2.5 Strike the second sentence in its entirety.

10.3 HAZARDOUS MATERIALS AND SUBSTANCES

10.3.3 Strike Section 10.3.3 in its entirety.

10.3.4 Insert “hazardous” in the last sentence after “handling of such”.

SUPPLEMENTARY GENERAL CONDITIONS 00 73 13-11
10.3.6 Strike Section 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR’S INSURANCE AND BONDS

11.1.1 Strike “Owner” from the third sentence.

11.2 OWNER’S LIABILITY INSURANCE

Strike 11.2 in its entirety, except that in the case of school projects in which case Section 11.2 shall remain.

11.3 WAIVERS OF SUBROGATION

Delete Section 11.3 in its entirety.

11.4 LOSS OF USE, BUSINESS INTERRUPTION, AND DELAY IN COMPLETION INSURANCE

Delete Section 11.4 in its entirety.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Section:

“12.2.2.1.1 At any time during the progress of the Work, or in any case where the nature of the defects will be such that it is not expedient to have corrected, the Owner, at its option, will have the right to deduct such sum, or sums, of money from the amount of the Contract as it considers justified to adjust the difference in value between the non-conforming work and that required under contract including any damage to the structure.”

12.2.2.1 Strike all references to “one year” or “one-year” and replace with “two years”.

12.2.2.2 Strike “one-year” and replace with “two years”.

12.2.2.3 Strike “one-year” and replace with “two years”.

12.2.5 Strike “one-year” and replaced with “two years”.

00 73 13-12 SUPPLEMENTARY GENERAL CONDITIONS
ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike the last sentence.

13.4 TESTS AND INSPECTIONS

13.4.1 Strike the last sentence and replace with the following:

“The Owner shall pay for tests, inspections, or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.”

13.5 INTEREST

Strike “the date payment is due at such rate as the parties may 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” and replace with “30 days of presentment of the authorized Certificate of Payment at the annual rate of 12% or 1% per month.”

Insert the following Section:

“13.6 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

13.6.1 If any provision, specifications or requirement of the Contract Documents conflict or is inconsistent with any statute, law or regulation of the government of the United State of America, the Contractor shall notify the Architect and Owner immediately upon discovery.”

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

14.1.1.4 Insert “, upon the Contractors’ request,” after “” furnish to the Contractor”.

14.1.3 Strike “and profit on Work not executed, and” after “as well as reasonable overhead” and replace with “, profit, and reasonable”

14.3 SUSPENSION BY OWNER FOR CONVENIENCE

14.3.2 Strike “Adjustment of the Contract Sum shall include profit”.

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

14.4.3 Strike Section 14.4.3 in its entirety and replace with the following:

“In case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed, and reasonable costs incurred by reason of such termination along with reasonable overhead.”
ARTICLE 15: CLAIMS AND DISPUTES

15.1 CLAIMS

15.1.2 TIME LIMITS ON CLAIMS

Strike the last sentence.

15.1.3 NOTICE OF CLAIM

Strike all references to “21” and replace with “45”.

15.1.5 CLAIMS FOR ADDITIONAL COSTS

Strike the first sentence and replace with the following:

“Contractor shall not proceed to execute any portion of the Work that is subject to the Claim without prior approval of the costs or method of payment for the costs associated with the Claim as determined by the Architect and approved by the Owner.”

15.1.7 WAIVER OF CLAIMS FOR CONSEQUENTIAL DAMAGES

Strike Section 15.1.7 in its entirety.

15.2 INITIAL DECISION

15.2.1 Strike “and binding dispute resolution” in the fourth sentence and replace with “or any and all remedies at law or in equity”.

15.2.5 Strike Section 15.2.5 in its entirety and replace with the following:

“The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be subject to mediation and any or all remedies at law or in equity.”

15.2.6 Strike Section 15.2.6 and its Subsections in their entirety.

15.3 MEDIATION

15.3.1 Strike “binding dispute resolution” and replace with “any or all remedies at law or in equity”.

15.3.2 Strike “, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedure in effect on the date of the Agreement,” in the first sentence.

15.3.2 Strike all references to “binding dispute resolution” and replace with “any or all remedies at law and in equity”.

SUPPLEMENTARY GENERAL CONDITIONS
15.3.3 Strike Section 15.3.3 in its entirety.

15.4 ARBITRATION

Strike Section 15.4 and its Subsections in their entirety.

END OF SUPPLEMENTARY GENERAL CONDITIONS
STATE OF DELAWARE

DIVISION OF FACILITIES MANAGEMENT

DELAWARE DEPARTMENT OF LABOR PREVAILING WAGE RATES
SEE THE FOLLOWING PAGES
### Prevailing Wages for Building Construction Effective March 13, 2020

<table>
<thead>
<tr>
<th>Classification</th>
<th>New Castle</th>
<th>Kent</th>
<th>Sussex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos Workers</td>
<td>24.35</td>
<td>29.99</td>
<td>43.65</td>
</tr>
<tr>
<td>Boilermakers</td>
<td>72.91</td>
<td>96.99</td>
<td>54.38</td>
</tr>
<tr>
<td>Bricklayers</td>
<td>57.94</td>
<td>57.94</td>
<td>57.94</td>
</tr>
<tr>
<td>Carpenters</td>
<td>56.46</td>
<td>56.46</td>
<td>44.83</td>
</tr>
<tr>
<td>Cement Finishers</td>
<td>76.91</td>
<td>53.57</td>
<td>23.61</td>
</tr>
<tr>
<td>Electrical Line Workers</td>
<td>48.43</td>
<td>41.53</td>
<td>31.66</td>
</tr>
<tr>
<td>Electricians</td>
<td>72.49</td>
<td>72.49</td>
<td>72.49</td>
</tr>
<tr>
<td>Elevator Constructors</td>
<td>93.07</td>
<td>68.69</td>
<td>34.03</td>
</tr>
<tr>
<td>Glaziers</td>
<td>77.23</td>
<td>77.25</td>
<td>60.35</td>
</tr>
<tr>
<td>Insulators</td>
<td>59.68</td>
<td>59.68</td>
<td>59.68</td>
</tr>
<tr>
<td>Iron Workers</td>
<td>67.70</td>
<td>67.70</td>
<td>67.70</td>
</tr>
<tr>
<td>Laborers</td>
<td>49.20</td>
<td>49.20</td>
<td>49.20</td>
</tr>
<tr>
<td>Millwrights</td>
<td>76.83</td>
<td>76.83</td>
<td>61.93</td>
</tr>
<tr>
<td>Painters</td>
<td>53.71</td>
<td>53.71</td>
<td>53.71</td>
</tr>
<tr>
<td>Piledrivers</td>
<td>79.62</td>
<td>41.92</td>
<td>33.90</td>
</tr>
<tr>
<td>Plasterers</td>
<td>31.79</td>
<td>31.79</td>
<td>23.56</td>
</tr>
<tr>
<td>Plumbers/Pipefitters/Steamfitters</td>
<td>72.05</td>
<td>56.29</td>
<td>62.21</td>
</tr>
<tr>
<td>Power Equipment Operators</td>
<td>73.29</td>
<td>73.29</td>
<td>73.29</td>
</tr>
<tr>
<td>Roofers-Composition</td>
<td>25.58</td>
<td>25.24</td>
<td>23.05</td>
</tr>
<tr>
<td>Roofers-Shingled/Slate/Tile</td>
<td>19.59</td>
<td>23.29</td>
<td>18.32</td>
</tr>
<tr>
<td>Sheet Metal Workers</td>
<td>75.03</td>
<td>75.03</td>
<td>75.03</td>
</tr>
<tr>
<td>Soft Floor Layers</td>
<td>54.59</td>
<td>54.59</td>
<td>54.59</td>
</tr>
<tr>
<td>Sprinkler Fitters</td>
<td>61.83</td>
<td>61.83</td>
<td>61.83</td>
</tr>
<tr>
<td>Terrazzo/Marble/Tile FNRS</td>
<td>66.75</td>
<td>66.75</td>
<td>66.75</td>
</tr>
<tr>
<td>Terrazzo/Marble/Tile Strs</td>
<td>74.02</td>
<td>74.02</td>
<td>74.02</td>
</tr>
<tr>
<td>Truck Drivers</td>
<td>32.77</td>
<td>29.22</td>
<td>22.75</td>
</tr>
</tbody>
</table>

**Certified:** 03/17/2020  
**By:** Administrator, Office of Labor Law Enforcement

**Note:** These rates are promulgated and enforced pursuant to the prevailing wage regulations adopted by the Department of Labor on April 3, 1992.

Classifications of workers are determined by the Department of Labor. For assistance in classifying workers, or for a copy of the regulations or classifications, phone (302) 451-3423.

Non-registered apprentices must be paid the mechanic's rate.

**Project:** 2020-WBZ-100 New Quarantine Support Building, New Castle County
PREVAILING WAGE DEBARMENT LIST

The following contractors have been debarred for violations of the prevailing wage law 29Del.C. §6960 or other applicable State statutes.

Therefore, no public construction contract in this State shall be bid on, awarded to, or received by contractors and individuals on this list for a period of (3) three years from the date of the judgment or as deemed by a court of competent jurisdiction.

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Address</th>
<th>Date of Debarment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mullen Brothers, Inc. and Daniel Mullen, individually</td>
<td>3375 Garnet Road, Boothwyn, PA 19060</td>
<td>Indefinite/ Civil Contempt</td>
</tr>
<tr>
<td>State Contractors Corporation, and Jose Oscar Rivera, individually</td>
<td>13004 Hathaway Drive Silver Spring, MD 20906</td>
<td>Indefinite/ 19 Del.C. 2374(f)</td>
</tr>
<tr>
<td>Green Granite and Jason Green, individually</td>
<td>604 Heatherbrooke Court Avondale, PA 19311</td>
<td>Indefinite/ Civil Contempt</td>
</tr>
<tr>
<td>Pro Image Landscaping, Inc. and Owner(s) individually</td>
<td>23 Commerce Street Wilmington, DE 19801 and/or 2 Cameo Road Claymont, DE 19703</td>
<td>Indefinite/19 Del.C. §108 &amp; 10 Del.C. 542(c)</td>
</tr>
<tr>
<td>Liberty Mechanical, LLC and Owner(s), individually</td>
<td>2032 Duncan Road Wilmington, DE 19801</td>
<td>Indefinite/ 19 Del.C. 2374(f)</td>
</tr>
<tr>
<td>Integrated Mechanical and Fire Systems Inc. and Allison Sheldon, individually</td>
<td>4601 Governor Printz Boulevard Wilmington, DE 19809</td>
<td>Indefinite/19 Del.C. §108 &amp; 10 Del.C. 542(c)</td>
</tr>
</tbody>
</table>

Updated: January 22, 2019
Pursuant to 29 Del.C. §8503(7), the Department of Labor, State of Delaware, hereby promulgates the following rules and regulations to implement the provisions of 29 Del.C. §6960, "Wage provisions in public construction contracts." These regulations supersede Regulations PW101, entitled "Regulations Concerning Apprentices and Supportive Service Program Trainees Employed on State Projects" (adopted April 11, 1978 and repealed April 5, 1992) and "Delaware Prevailing Wage Regulations" (adopted April 5, 1992 as amended September 15, 1993).

1 DE Reg. 519 (11/1/97)

1.0 Introduction

The prevailing wage law states that the specifications for every contract or aggregate of contracts relating to a public works project in excess of $500,000 for new construction (including painting and decorating) or $45,000 for alteration, repair, renovation, rehabilitation, demolition or reconstruction (including painting and decorating of building or works) to which this State or any subdivision thereof is a party and for which the State appropriated any part of the funds and which requires or involves the employment of mechanics and/or laborers shall contain a provision stating the minimum wages to be paid various classes of laborers and mechanics which shall be based upon the wages that will be determined by the Delaware Department of Labor, Division of Industrial Affairs, to be prevailing in the county in which the work is to be performed.

19 DE Reg. 415 (11/01/15)

2.0 Administration

The prevailing wage law assigns to the Department of Labor the responsibility for predetermining wage rates prevailing for the corresponding classes of laborers and mechanics employed on projects similar to the contract work in the counties where the work is to be performed. The Secretary of Labor has delegated the prescribed functions of the Department to the Administrator of the Office of Labor Law Enforcement of the Division of Industrial Affairs. The Office of Labor Law Enforcement has responsibility for enforcing and determining the prevailing rates, and ensuring that prevailing wages are paid in accordance with the provisions of the law.

Enforcement responsibility includes the conducting of investigations regarding compliance with the law; settling, adjusting and adjudicating, by informal means, cases involving the payment of prevailing wages; coordinating the enforcement activities of the various State agencies having contract compliance and enforcement responsibilities; requiring the withholding of payments to employers who have failed to pay prevailing wages; and recommending the commencement of legal proceedings against those failing to comply with the law.

3.0 Concepts and Definitions

3.1 This section presents definitions and explanations to provide a basic understanding of elements inherent in collecting wage data and issuing wage determinations, and enforcing prevailing rates.

3.1.1 Activity Covered. 29 Del.C. §6960 applies to every contract or aggregate of contracts relating to a public works project in excess of $500,000 for new construction (including painting or decorating) or $45,000 for alteration, repair, renovation, rehabilitation, demolition or reconstruction (including painting and decorating of building or works) to which this State or any subdivision thereof is a party and for which the State appropriated any part of the funds and which requires or involves the employment of mechanics and/or laborers.

3.1.2 "Building" or "Work". The terms "building" or "work" generally include construction activity as distinguished from manufacturing, furnishing of materials, or servicing and maintenance work. The terms include without limitation, buildings, structures, and improvements of all types, such as bridges, dams, plants, highways, parkways, streets, tunnels, sewers, mains, power lines, pumping stations, heavy generators, railways, airports, terminals, docks, piers, wharves, buoys, jetties, breakwaters, levees, canals, dredging, shoring, rehabilitation and reactivation of plants, scaffolding, drilling, blasting, excavating, clearing, and landscaping. The manufacture or furnishing of materials, articles, supplies or
equipment is not a "building" or "work" within the meaning of the regulations unless conducted at the site of such a building or work.

3.1.3 Laborers and Mechanics. The terms "laborer" and "mechanic" includes at least those workers whose duties are manual or physical in nature (including those workers who use tools or who are performing the work of a trade), as distinguished from mental or managerial. The term "laborer" or "mechanic" includes apprentices and Supportive Service Program (SSP) trainees. The term does not apply to workers whose duties are primarily administrative, executive, or clerical, rather than manual. Persons employed in a bona fide executive, administrative, or professional capacity are not deemed to be laborers or mechanics. Working foremen who devote more than twenty (20) percent of their time during a workweek to mechanic or laborer duties are deemed to be laborers and mechanics for the time so spent.

The terms "laborers" and "mechanics" do not apply to watchmen, guards, dispatchers, or weighmasters. The following classifications of workers are recognized by the Department:

- Asbestos Workers
- Boilermakers
- Bricklayers
- Carpenters
- Cement Finishers
- Electrical Line Worker
- Electricians
- Elevator Constructors
- Glaziers
- Insulators
- Iron Workers
- Laborers
- Millwrights
- Painters
- Pile Driver
- Plasterers
- Plumbers/Pipefitters/Steamfitters
- Power Equipment Operators
- Roofer- Composition
- Roofer - Shingle, Slate and Tile
- Sheet Metal Workers
- Soft Floor Layers
- Sprinkler Fitters
- Terrazzo/Marble/Tile Setters
- Terrazzo/Marble/Tile Finishers
- Truck Drivers

Definitions for each classification are contained in a separate document entitled, "Classifications of Workers Under Delaware’s Prevailing Wage Law." Workers shall be classified by the Department of Labor. Classification determinations shall be recorded by the Department as they are made.

Laborers and mechanics are to be paid the appropriate wage rates for the classification of work actually performed, without regard to skill.

3.1.4 Apprentices and Supportive Service Program Trainees.

3.1.4.1 Definitions. As used in this section:

3.1.4.1.1 The term "apprentice" means persons who are indentured and employed in a bona fide apprenticeship program and individually registered by the program sponsor with the Delaware Department of Labor.

3.1.4.1.2 The term "apprenticeship agreement" means a written agreement between an apprentice and either his/her employer or a joint apprenticeship committee which contains the terms and conditions of the employment and training of the apprentice.
3.1.4.1.3 The term "apprenticeship program" means a complete plan of terms and conditions for the employment and training of apprentices.

3.1.4.1.4 The term "Joint apprenticeship committee" means a local committee equally representative of employers and employees which has been established by a group of employers with a bona fide bargaining agent or agents to direct the training of apprentices with whom it has made agreements.

3.1.4.1.5 The term "registration" means the approval by the Department of Labor of an apprenticeship program or agreement as meeting the basic standards adopted by the Bureau of Apprenticeship and Training, United States Department of Labor. The term "registration" for SSP Trainees means the individual registration of a participant in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

3.1.4.1.6 The term "SSP Trainee" or "trainee" means a participant in the "Supportive Service Program" mandated by the Federal Highway Administration for federally aided state highway projects.

3.1.4.2 Employment of Apprentices and SSP Trainees on State Projects.

3.1.4.2.1 Apprentices and SSP Trainees will be permitted to work as such on State contracts in excess of $100,000 for new construction or $15,000 for alteration, repair, renovation, rehabilitation, demolition or reconstruction only when they are registered with the Department of Labor or an approved SSP Training Program.

3.1.4.2.2 The mechanic's rate on all such State contracts is that rate determined by the Department of Labor. The percentage of the mechanic's rate that the registered apprentice or SSP Trainee receives will be the percentage that the apprentice or trainee qualifies for under the terms of the individual's formal Apprenticeship/Trainee agreement.

3.1.4.2.3 Any person employed at an apprentice or trainee wage rate who is not registered as above, shall be paid the wage rate determined by the Department of Labor for the classification of work (s)he actually performed.

3.1.4.2.4 The ratio of apprentices to mechanics on the site of any work covered by 29 Del.C. §6960 in any craft classification may not be greater than the ratio permitted to the contractor for the entire workforce under the registered apprenticeship program. Any apprentice performing work on the job site in excess of the ratio permitted under the registered program must be paid not less than the wage rate that the applicable wage determination specifies for the work (s)he actually performs. Entitlement to mechanic's wages shall be based upon seniority in the apprenticeship program or (in the case of equal seniority) seniority on the job site.

3.1.4.3 Records.

3.1.4.3.1 Every employer who employs an apprentice or SSP trainee under this part must keep the records required by 19 Del.C. Chs. 9 and 11, including designation of apprentices or trainees on the payroll. In addition, every employer who employs apprentices or SSP trainees shall preserve the agreements under which the individuals were employed.

3.1.4.3.2 Every joint apprenticeship committee or SSP Program sponsor shall keep a record of the cumulative amount of work experience gained by the apprentice or trainee.

3.1.4.3.3 Every joint apprenticeship committee shall keep a list of the employers to whom the apprentice was assigned and the period of time (s)he worked for each. Every SSP Program sponsor shall keep a list of the projects to which the trainee was assigned and the period of time (s)he worked on each.

3.1.4.3.4 The records required by sections 3.1.4.3.1, 3.1.4.3.2, and 3.1.4.3.3 shall be maintained and preserved for at least three (3) years from the termination of the apprenticeship or training period. Such records shall be kept safe and accessible at the place or places of employment or at a central location where such records are customarily maintained. All records shall be available at any time for inspection and copying by the Department of Labor.

3.1.5 Working Foremen. 29 Del.C. §6960 does not apply to (and therefore survey data are not collected for) workers whose duties are primarily administrative, executive or clerical, rather than manual. However, working foremen who devote more than twenty (20) percent of their time during a workweek to mechanic or laborer duties are laborers and mechanics for the time so spent and data will be collected for the hours spent as laborers or mechanics.
Title 19 Labor
Delaware Administrative Code

3.1.6 Helpers. Helper classifications are not recognized by the Department of Labor. All laborers and mechanics are to be paid the appropriate wage rate for the classification of work actually performed, without regard to skill.

3.1.7 Construction Projects. In the wage determination process, the term “project” refers to construction activity as distinguished from manufacturing, furnishing of materials, or servicing and maintenance work away from the site of the work and consists of all construction necessary to complete a facility regardless of the number of contracts involved so long as all contracts awarded are closely related in the purpose, time and place. For example, demolition or site clearing work preparatory to construction is considered a part of the project.

3.1.7.1 Character Similar. 29 Del.C. §6960 requires the predetermination of wage rates which are prevailing on projects of a “character similar to the construction work.” As a general rule, the Department identifies projects by end use type and classifies them into three major categories:

3.1.7.1.1 Building Construction. Building construction generally is the construction of sheltered enclosures with walk-in access for the purpose of housing persons, machinery, equipment, or supplies. It includes all construction of such structures, the installation of utilities and the installation of equipment, both above and below grade level as well as incidental grading, utilities and paving. Additionally, such structures need not be “habitable” to be building construction. The installation of heavy machinery and/or equipment shall not change the project’s character as a building. Examples: Alterations and additions to nonresidential buildings; Apartment buildings (5 stories and above); Arenas (enclosed); Auditoriums; Automobile parking garages; Banks and financial buildings; Barracks; Churches; Hospitals; Hotels; Industrial buildings; Institutional buildings; Libraries; Mausoleums; Motels; Museums; Nursing and convalescent facilities; Office buildings; Outpatient clinics; Passenger and freight terminal buildings; Police Stations; Post offices; City halls; Civic centers; Commercial buildings; Court houses; Detention facilities; Dormitories; Farm buildings; Fire stations; Power plants; Prefabricated buildings; Remodeling buildings; Renovating buildings; Repairing buildings; Restaurants; Schools; Service stations; Shopping centers; Stores; Subway stations; Theaters; Warehouses; Water and sewage treatment plants (building only).

3.1.7.1.2 Heavy Construction. Heavy projects are those that are not properly classified as either “building” or “highway.” Unlike these classifications, heavy construction is not a homogeneous classification. Examples of Heavy construction: Antenna towers; Bridges (major bridges designed for commercial navigation); Breakwaters; Caissons (other than building or highway); Canals; Channels; Channel cut-offs; Chemical complexes or facilities (other than buildings); Cofferdams; Coke ovens; Dams; Demolition (not incidental to construction); Dikes; Docks; Drainage projects; Dredging projects; Electrification projects (outdoor); Flood control projects; Industrial incinerators (other than building); Irrigation projects; Jetties; Kilns; Land drainage (not incidental to other construction); Land leveling (not incidental to other construction); Land reclamation; Levees; Locks; Waterways; oil refineries; Pipe lines; Ponds; Pumping stations (pre-fabricated drop-in units); Railroad construction; Reservoirs; Revetments; Sewage collection and disposal lines; Sewers (sanitary, storm, etc.); Shoreline maintenance; Ski tows; Storage tanks; swimming pools (outdoor); Subways (other than buildings); Tipples; Tunnels; Unsheltered piers and wharves; Viaducts (other than highway); Water mains; Waterway construction; Water supply lines (not incidental to building); Water and sewage treatment plants (other than buildings); Wells.

3.1.7.1.3 Highway Construction. Highway projects include the construction, alteration or repair of roads, streets, highways, runways, taxiways, alleys, trails, paths, parking areas, greenway projects and other similar projects not incidental to building or heavy construction. Examples: Alleys; Base courses; Bituminous treatments; Bridle paths; Concrete pavement; Curbs; Excavation and embankment (for road construction); Fencing (highway); Grade crossing elimination (overpasses or underpasses); Parking lots; Parkways; Resurfacing streets and highways; Roadbeds; Roadways; Shoulders; Stabilizing courses; Storm sewers incidental to road construction; Street Paving; Guard rails on highway; Highway signs; Highway bridges (overpasses; underpasses; grade separation); Medians; Surface courses; Taxiways; Trails.

3.1.7.1.4 Multiple Categories. In some cases a project includes construction items that in themselves encompass different categories of construction. Generally, a project is considered mixed and a "multiple schedule" used if the construction items are substantial in relation to project cost, i.e.
more than twenty (20) percent. Only one schedule is used if construction items are "incidental" in function to the overall character of a project (e.g., paving of parking lots or an access road on a building project), and if there is not a substantial amount of construction in the second category.

3.1.7.2 Site of Work. A basic characteristic of the construction industry is the continual shift in the site of employment. 29 Del.C. §6960 provides that prevailing wages are to be paid to "...all mechanics and laborers employed directly upon the site of the work..." (emphasis added). The site of the work is limited to the physical place or places where the construction called for in the contract will remain when work on it has been completed.

3.1.8 Prevailing Wage Rates. Every contract and the specifications for every contract to which section 6960 applies are required to contain a provision stating the minimum wages to be paid various classes of laborers and mechanics. These rates are to be based upon the wages that the Department of Labor determines to be prevailing for the corresponding classes of laborers and mechanics employed on projects of a character similar to the contract work in the county in which the work is to be performed, as reported in the Department's annual prevailing wage survey.

The prevailing wage shall be the wage paid to a majority of employees performing similar work as reported in the Department's annual prevailing wage survey or, in the absence of a majority, the weighted average wage paid to all employees reported.

3.1.9 Wages. The term "wages" means the basic hourly rate of pay plus fringe benefits as defined below.

3.1.10 Fringe Benefits. Fringe benefits may be considered in determining whether an employer has met his/her prevailing wage obligations. As a general rule, any fringe benefit may be considered as long as the employer is not legally required to provide it. Therefore, benefits such as health, welfare or retirement benefits, vacation, holiday pay or sick leave pay could be considered fringe benefits. Employer payments for unemploymentinsurance, workers' compensation, FICA, etc. (which are required by law) would not be considered fringe benefits.

In order to be considered a valid fringe benefit, payments must be made either in cash, or contributed to an irrevocable escrow account at least once each month.

"Irrevocable" means that the benefit may not be forfeited. However, a benefit plan can be considered by the Department provided that payments to the plan are made irrevocably by the employer, even though certain employees may forfeit their individual rights to the benefits under certain prescribed conditions. Thus, if payments are made by the employer, and no return of those payments is possible, the plan would be acceptable, even though individual employees might not receive the benefits under certain situations. Benefits forfeited by such employees remain in an escrow account for the use of the other employees.

The actual cost of the benefit to the employer is the basis for evaluating the value of the fringe benefit. Administration costs are not considered fringe benefits. The cost of the benefits must be apportioned between employment on both public and private projects. Thus, the total value of the benefit would be divided by the total amount of time worked. This will result in benefit per unit of time which would be equally applicable to public and private employment projects. Example: an employee works two weeks (80 hours) on a public project and two weeks (80 hours) on a private project. The employer pays $160 for the employee's health insurance for the month. The value of the benefit is $1.00 per hour. The employer is not permitted to apply the entire premium to the public project alone.

3.1.11 Peak Week. In determining prevailing wages, the Department utilizes a "peak week" survey concept to ensure that wage and fringe benefit data obtained from employers reflects for each classification, the payroll period during which the greatest number of workers in each classification are used on a project. The survey solicits the number of employees and wages paid at each given rate during the peak week. The contractor or reporting organization selects the week (between July 1 to December 31 of the previous year) during which the greatest number of each classification of laborers and mechanics was working. Peak weeks may be different for each classification of worker.

3.1.12 Wage Determinations. A "wage determination" is the listing of wages (including fringe benefits) for each classification of laborers and mechanics, which the Administrator has determined to be prevailing in a given county and type of construction. Wage determinations are issued annually.

3.1.13 Maintenance Work. To "maintain" means to preserve or keep in an existing state or condition to prevent a decline, lapse, or cessation from that state or condition. Wages paid to workers performing maintenance work shall not be used in determining prevailing wage rates.
3.1.14 Area. The term "area" in determining wage rates under 29 Del.C. §6960 shall mean the county of the State in which the work is to be performed. The term "area" in determining classifications of workers under 29 Del.C. §6960 shall mean the State of Delaware.

3.1.15 Secretary. "Secretary" means the Secretary of Labor for the State of Delaware.

3.1.16 Administrator. "Administrator" means the Administrator of the Office of Labor Law Enforcement for the Delaware Department of Labor, Division of Industrial Affairs.

3.1.17 Department. "Department" means the Delaware Department of Labor.

4.0 Determining Prevailing Wages

4.1 The Department of Labor shall conduct an annual survey for obtaining and compiling wage rate information and shall encourage the voluntary submission of wage data by contractors, contractors associations, labor organizations, public officials and other interested parties, reflecting wage rates paid to laborers and mechanics on various types of construction in the area.

4.1.1 Scope of Task. State directed and assisted construction activity is not restricted to any geographic sector of the state or to any particular type of construction. As a result, data collection methods employed by the Department for gathering prevailing wage information must be capable of determining patterns of wage compensation, including fringe benefits, for virtually all classifications of construction workers in at least the three major types of construction, within each of the three counties in Delaware. And, since the objective is determining "prevailing" wages, the collection of data must be completed within a relatively brief time frame.

4.1.2 Data to be Collected. Operation of the prevailing wage program necessitates an annual effort by the Department to obtain, compile and analyze wage rate information. This section explores the nature of the data and the means of collection.

4.1.2.1 What Information. Wage rates are issued for each classification of laborer and mechanic that will likely be employed in State funded or assisted construction in a certain type of construction. Information on wages paid, therefore, must be collected and tabulated on the basis of distinct job classifications and construction categories.

The survey reporting form used by the Department to collect wage and fringe information, "Report of Construction Wage Rates", provides for reporting data which includes the contractor's name and address, telephone number, project description and location, the highest number of workers employed in each classification during the peak week of the period being surveyed (which shall be within the period July 1 to December 31 of the year preceding the request for data) and the wage rate, including bona fide fringe benefits, paid to each worker.

4.1.2.2 Geographic Scope. A prime objective of the prevailing wage law is to protect local rates of pay and 29 Del.C. §6960 stipulates that the "area" for the determination of wage rates is to be the county in which the work is performed.

5.0 The Survey

5.1 The purpose of prevailing wage surveys is to collect information on wage and fringe benefit rates paid to mechanics and laborers working on construction projects of a similar character in a predetermined geographic area and calendar period. The Department attempts to give each contractor equal opportunity to be included in the final data base from which the prevailing rates are derived.

The Department shall conduct the survey in accordance with the following steps:

5.1.1 Plan the Survey.

The Department shall begin the survey preparation process no later than November of each year. Forms will be printed and supplies (envelopes, postage, etc.) will be ordered in preparation for the survey mailing. In addition, the Department will set up the external electronic production for submittal of survey information. The Department will request from the Division of Unemployment Insurance a computer
printout (with two sets of address labels) of the names and addresses of all employers in the following North American Industry Classification System (NAICS) Codes, who reported workers during the calendar year in which the request is made:

- 236116 New Multifamily Housing Construction (except For-Sale Builders)
- 236118 Residential Remodelers
- 236220 Commercial and Institutional Building Construction
- 236210 Industrial Building Construction
- 236220 Commercial and Institutional Building Construction
- 237310 Highway, Street, and Bridge Construction
- 237990 Other Heavy and Civil Engineering Construction
- 237110 Water and Sewer Line and Related Structures Construction
- 237120 Oil and Gas Pipeline and Related Structures Construction
- 237130 Power and Communication Line and Related Structures Construction
- 236210 Industrial Building Construction
- 237110 Water and Sewer Line and Related Structures Construction
- 237120 Oil and Gas Pipeline and Related Structures Construction
- 237130 Power and Communication Line and Related Structures Construction
- 237990 Other Heavy and Civil Engineering Construction
- 238910 Site Preparation Contractors
- 238210 Electrical Contractors and Other Wiring Installation Contractors
- 238220 Plumbing, Heating, and Air-Conditioning Contractors
- 238910 Site Preparation Contractors
- 238320 Painting and Wall Covering Contractors
- 238210 Electrical Contractors and Other Wiring Installation Contractors
- 238140 Masonry Contractors
- 238310 Drywall and Insulation Contractors
- 238340 Tile and Terrazzo Contractors
- 238130 Framing Contractors
- 238350 Finish Carpentry Contractors
- 238330 Flooring Contractors
- 238160 Roofing Contractors
- 238170 Siding Contractors
- 238390 Other Building Finishing Contractors
- 238110 Poured Concrete Foundation and Structure Contractors
- 238140 Masonry Contractors
- 238990 All Other Specialty Trade Contractors
- 238120 Structural Steel and Precast Concrete Contractors
- 238190 Other Foundation, Structure, and Building Exterior Contractors
- 238150 Glass and Glazing Contractors
- 238910 Site Preparation Contractors
- 238220 Plumbing, Heating, and Air-Conditioning Contractors
- 238290 Other Building Equipment Contractors
- 238150 Glass and Glazing Contractors
- 238190 Other Foundation, Structure, and Building Exterior Contractors
- 238290 Other Building Equipment Contractors
- 561790 Other Services to Buildings and Dwellings
- 562910 Remediation Services

The Department will begin to assemble the survey packets in mid-December of each year in preparation for the early January mailing.  

5.1.2 Conduct the Survey.

On or before January 7th of each-year, survey forms will be mailed to every employer identified by the Division of Unemployment Insurance as having employed workers in the NAICS Codes listed above during the calendar year preceding the collection of data. Completed survey forms and electronic submission of survey data must be received by the Department or postmarked no later than February 8 of the survey year in order to be used in determining prevailing rates for that year. All other forms not complying with this deadline shall not be included. In the event that February 8th falls on a Saturday, Sunday, or legal holiday,
the deadline for submitting survey forms shall be the next Department business day following the February 8th deadline.

By January 10th of each year, the Department shall notify the Delaware Contractor’s Association, the Building Trades Council of Delaware, the Associated Builders and Contractors, the Delaware State AFL-CIO, the Secretary of the Department of Administrative Services, the Secretary of the Department of Transportation and the Roofing Contractors Association that the annual survey is being conducted. The notification shall contain a copy of the list of employers to whom survey forms were mailed and shall invite the addressees to submit the names and addresses of any employers whose names do not appear on the list. The notification shall also contain blank survey forms for the organizations’ use.

The Department shall also notify the Local Unions whose collective bargaining wage rate has prevailed to submit their collective bargaining wage rate on forms provided by the Department and a copy of their current collective bargaining wage sheet to be entered as the prevailing wage rate for the survey which is being conducted.

As of January 1, 2016, the Delaware Department of Labor, Division of Industrial Affairs shall establish the prevailing wage for each respective craft or class of laborers and mechanics at the same rates established in collective bargaining agreements between labor organizations and their employers, or when collective bargaining agreement rates do not prevail, that govern work of a similar nature and similar crafts or classes of laborers and mechanics for the county where the public works contract will be performed if that particular labor organization’s collective bargaining rate prevailed and they participated in the survey, for that particular trade or craft in that particular county for 4 consecutive years. When collective bargaining rates do not apply, the prevailing wage shall be the highest rate of the 4 years. If the agreed rate of pay is designated to be the craft’s collective bargaining agreement, the annual rate adjustment will be determined by the collective bargaining agreement rate for each craft and county, each year.

When collective bargaining rates do not prevail, the annual rate adjustment shall be the Consumer Price Index-Construction. If the prevailing wage cannot be reasonably and fairly determined in any locality because no such agreements exists or the collective bargaining rate has not prevailed for 4 consecutive years the Department shall use the prevailing wage as established by the Department's annual prevailing wage survey.

For each respective craft or class of laborers or mechanics, the craft or class whose collectively bargained wages as of January 1, 2015, for that particular labor organization’s collective bargaining rate prevailed for that particular trade or craft in that particular county is the prevailing wage rate and whose rate has prevailed for 4 of the last 5 years, or will prevail in the future for 4 consecutive years, shall have their collective bargaining agreement adopted as the prevailing wage rate negotiated by industry standards between workers and employers and the raise be determined by the collective bargaining agreement rate as of September 1 for that craft, county, and year.

5.1.3 Conduct Follow-Up.

On or before February 1st of each year, the Department shall mail a second notice to all employers who failed to respond to the first request for data. A second copy of the Department’s master mailing list (indicating the employers who responded) shall be sent to the organizations listed in the preceding paragraph so that they can encourage the voluntary participation of their members.

5.1.4 Clarify and Analyze Data.

The data clarification process is to begin immediately upon receipt of survey responses. Each survey response is reviewed to determine completeness, appropriateness, and accuracy of data.

5.1.5 Code and Record Data.

Received by Mail survey responses are to be coded as follows:

"A"  Survey response is usable (i.e., it is timely, complete, appropriate, and accurate)
"B"  Employer reports no employees during survey period
"C"  Survey response is incomplete
"D"  Survey response is not applicable
"E"  Survey request not deliverable at address used/Respondent not identified on survey form/Information is not usable

5.1.6 Electronic Data

Electronic data will be reviewed daily and be accepted or denied based upon the same criteria listed in subsection 5.1.5.
Data from usable responses are to be recorded weekly electronically in a summary ledger which contains a breakdown of each classification of worker for each type of construction for each county. Survey responses coded "A" shall be filed by county and type of construction. Survey responses coded "B", "D", and "E" shall be kept in files separate from the usable responses. Respondents who submit code "C" survey responses (incomplete) shall be contacted by telephone by the Department. The Department will give the respondent an opportunity to supply the missing information. Failure to submit the missing information prior to the publication of the Prevailing Wage determination (see Section 6.3) will result in a disqualification of the survey response (to the extent that it is not usable).

The master mailing list shall be coded weekly to show the identity of survey participants as well as the number and types of responses.

All survey responses and documents are to be retained by the Department for a period of three years.

5.1.7 Determine Adequacy of Data.
At the conclusion of the survey period, the Department will review the survey ledger to determine the adequacy of data in each classification in each type of construction in each county. Data will be considered adequate if the worker classification contains the wages of ten or more employees. Classification data not meeting the above criteria will be added to the previous year's survey data for the same classification. If the data still do not reflect the wages paid to at least ten workers, the data will be considered inadequate.

5.1.8 Compute Prevailing Wage Rates.
The Department will enter usable data (from the summary ledgers) in the computer. If a majority (i.e., more than 50% of the workers reported in a particular category are paid at the same rate, that rate shall be the prevailing wage rate for the classification. For example:

<table>
<thead>
<tr>
<th>Laborers / New Castle county / Building Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workers Rate of Pay (including benefits)</td>
</tr>
<tr>
<td>50 @ $17.25 = Majority</td>
</tr>
<tr>
<td>39 @ 16.75</td>
</tr>
<tr>
<td>10 @ 17.55</td>
</tr>
<tr>
<td>99</td>
</tr>
</tbody>
</table>

The prevailing wage rate $17.25

In the absence of a majority, the computer will determine the average (mean) of the wages-paid, weighted by the numbers of workers paid at each rate. For example:

<table>
<thead>
<tr>
<th>Laborers/New Castle County/Building Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workers Rate of Pay (including benefits)</td>
</tr>
<tr>
<td>25 @ $15.50 = $387.50</td>
</tr>
<tr>
<td>25 @ 17.25 = 431.25</td>
</tr>
<tr>
<td>39 @ 16.75 = 653.25</td>
</tr>
<tr>
<td>10 @ 17.55 = 175.50</td>
</tr>
<tr>
<td>99 $1,647.50</td>
</tr>
</tbody>
</table>

$1,647.50 ÷ 99 workers = $16.64 prevailing rate

5.1.9 Determine Wage Rates for Classes of Workers For Which Inadequate Data Are Received.
The Department is required by law to determine wages to be paid to all classes of workers employed on public projects. For that reason, the Department must have a means by which it can determine rates for which no data or inadequate data were received. If no data are received for a given classification, or if inadequate data are received (i.e., fewer than 10 workers reported in a given classification), the previous year's prevailing rates shall be reissued.

1 DE Reg. 519 (11/1/97)
19 DE Reg. 415 (11/01/15)

6.0 Issuing Wage Determinations
6.1 Publication of Preliminary Determination.
On or before February 15th of each year, the Department shall publish a "Preliminary Determination of Prevailing Wage Rates." In the event that February 15th falls on a Saturday, Sunday, or legal holiday, the Department shall issue the preliminary results on the next Department business day following February 15th.
6.2 Appeals.
From February 15th to February 25th, the Administrator of the Office of Labor Law Enforcement will consider protests and inquiries relating to the preliminary results. An interested person seeking review or reconsideration of a wage determination must present a request in writing accompanied by a statement with any supporting data or other pertinent information.

Requests for reconsideration must be substantive and specific in order to be considered by the Department. For example: A request stating that, "the highway rates don't look right", would not be considered substantive or specific. However, a request stating that, "residential rates appear to have been erroneously included for carpenters in New Castle County Building Construction" would be considered substantive and specific.

From February 25th to March 1st, the Department will attempt to gather information necessary to resolve objections and requests for reconsideration. However, no appeals, objections, or requests will be considered if received by the Department after the February 25th deadline. The Department will respond in writing to all interested persons who submit a written request for review.

An appeal from the Administrator's decision must be made in writing and received by the Secretary of Labor within five calendar days from the date of the postmark on the Administrator's decision. The Secretary or his/her designee shall render a final decision in writing.

6.3 Issuance of Determination
On or before March 15th of each year, the Department shall publish its annual "Prevailing Wage Determination." The Determination shall be valid for a period of one year or until subsequent rates or amendments are issued by the Department.

Public agencies (covered by the provisions of 29 Del.C. §6960) are required to use the rates which are in effect on the date of the publication of specifications for a given project. "Date of publication" means the date on which the specifications are made available to interested persons (as specified in the published bid notice). In the event that a contract is not executed within one hundred and twenty (120) days from the earliest date the specifications were published, the rates in effect at the time of the execution of the contract shall be the applicable rates for the project.

6.4 Post Determination Actions. Wage determinations will be modified only for the purpose of correcting errors. Determinations will not be modified to include survey data received after the close of the survey period.

6.4.1 Amendment to Correct Errors of Inadvertence. Amendments may be issued to correct inadvertent errors in the written text of a wage determination. The sole purpose is to correct wage schedules so that the wage determination will accurately and fully reflect the actual rates prevailing in the locality at the time the wage determination was issued. Such amendments (which may be issued at any time) are used to correct errors due to transposition of rates and other clerical mistakes made in processing the schedule; they are not used to correct errors in judgment. Contracts which have already been awarded will not be affected by such amendments. Amendments issued more than ten (10) days prior to a bid opening must be used. Amendments issued less than ten (10) days prior to a bid opening may be disregarded.

6.4.2 Amendment to Correct Errors in Survey Data. Amendments which affect the validity of a wage determination may be issued to correct errors in rates resulting from erroneous information submitted by survey participants.

When the Department of Labor is notified in writing that a survey participant has submitted erroneous data (with regard to wages, fringe benefits, characterization of project, classification of workers, or county in which the work was performed), the Department shall determine the validity of the data. Corrections, if warranted, shall be made in the form of amended determinations at the end of each calendar quarter (beginning with the date the wage determination was issued). Contracts which have already been awarded will not be affected by such amendments. Amendments issued more than ten (10) days prior to a bid opening must be used. Amendments issued less than ten days prior to a bid opening may be disregarded.

6.4.3 Incorrect Wage Determinations: Before Contract Award.
If notification is received from the Department of Labor any time prior to the contract award that the bid documents contain the wrong wage schedule, such schedule or wage determination shall no longer be valid and may not be used - without regard to whether the bid opening has occurred.

If the bid documents contain no wage schedule, it is the contractor's (or subcontractor's) responsibility to contact the Department of Labor for the correct wage schedule. Such requests must be in writing. Responses to such requests will be in writing. Any contractor or subcontractor found using an incorrect
wage schedule will be required to pay the correct wages based upon the proper classification of work as determined by the Department of Labor.

6.4.4 Lack of Valid Wage Determination: After Contract Award. If a contract is awarded without a wage determination or awarded with an incorrect wage determination, the contractor is responsible for the payment of the appropriate prevailing wage rates as determined by the Department of Labor.

6.4.5 Additional Classifications. Any class of laborers or mechanics which is not listed in the applicable wage determination but which is to be employed under the contract is to be classified by the Department of Labor in accordance with the procedures set forth in subsection 3.1.3 of these regulations.

6.4.6 Determination of Wages for Classifications for Which No Rates Are Published. Whenever a public project requires the services of a laborer or mechanic for which no rate has been published, the Department shall be notified in writing and shall determine the worker classification (from among the 26 classifications recognized by the Department of Labor) and the rate to be paid. The rate shall be determined as follows:

6.4.6.1 baseline rate in each county, the Department of Labor will determine the relationship between the "Building Construction" rates and the rates of the type of construction for which the rate is sought. To determine the relationship, (which is to be expressed as a percentage), the Department will use only those rates which were determined by data received in the relevant survey.

6.4.6.2 The Department will compare only those classifications for which corresponding rates were determined.

6.4.6.3 The total of the corresponding rates will be determined for each type of construction. The Heavy or Highway total will be divided by the Building rate to find what percentage of the Heavy or Highway rate to the Building rate.

6.4.6.4 The Department of Labor will multiply the Building rate for the requested classification of worker by the percentage determined in "c" to establish the applicable prevailing wage rate.

Hypothetical example:
A plumber's rate is needed for a New Castle County project. The Department of Labor has not published a rate for this classification. The Department of Labor will determine the relationship between New Castle County Highway rates and Building rates, comparing only corresponding rates which were actually determined by the relevant survey (rates carried forward from previous years due to lack of sufficient data are not to be used).

<table>
<thead>
<tr>
<th>N.C.C. Building</th>
<th>N.C.C. Highway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bricklayers</td>
<td>$19.65 $12.29</td>
</tr>
<tr>
<td>Carpenters</td>
<td>$23.37 $21.69</td>
</tr>
<tr>
<td>Cement Finishers</td>
<td>$23.55 $15.52</td>
</tr>
<tr>
<td>Laborers</td>
<td>$13.62 $10.60</td>
</tr>
<tr>
<td>Power Equipment Operator</td>
<td>$22.94 $15.77</td>
</tr>
<tr>
<td>Truck Drivers</td>
<td>$15.15 $13.75</td>
</tr>
<tr>
<td>$118.28 $89.62</td>
<td>$89.62 ÷ 118.28 = 75.77%</td>
</tr>
<tr>
<td>The plumber's rate for New Castle County Building is $26.54. $26.54 x 75.77% = $20.11</td>
<td></td>
</tr>
<tr>
<td>The plumber's rate for New Castle County Highway = $20.11</td>
<td></td>
</tr>
</tbody>
</table>

The same method can be used between corresponding types of construction when the Building construction rates do not contain a rate for the requested classification of worker; i.e., Heavy construction rates in Sussex County can be compared with Heavy construction rates in New Castle.

1 DE Reg. 519 (11/1/97)
5 DE Reg. 205 (7/1/01)
7 DE Reg. 518 (10/1/03)
19 DE Reg. 415 (11/01/15)

7.0 Enforcement

7.1 The authority to enforce the prevailing wage rates derives from 29 Del.C. §6960(b) which states: “The Department of Labor shall investigate all claims that the prevailing wage rates as provided for under this section are not being or have not been paid.”
7.1.1 Duties of Contractors. Every contractor and subcontractor on a public project shall:

7.1.1.1 Post in a prominent and accessible place at the site of the work, a legible copy of the applicable prevailing wage determination issued by the Department. The notice must remain posted during the life of the contract and must be supplemented in its entirety whenever amended wage rate determinations are issued by the Department.

7.1.1.2 Pay all mechanics and laborers employed directly upon the site of the work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at the time of payment, computed at wage rates not less than those stated in the prevailing wage rate determination.

7.1.1.2.1 Laborers or mechanics performing work in more than one occupation shall be compensated at least the rate specified for each occupation for the time actually worked therein.

7.1.1.2.2 An employer shall not pay or permit any worker to accept wages less than the prevailing rate of wages as determined by the Department;

7.1.1.2.3 Every employer performing work on a public project shall furnish weekly payroll reports to the Department of Labor on forms provided (upon request) by the Department. Payroll reports shall be mailed or delivered by the employer to the Department within one week from the last work day covered by the report. Failure to complete each and every section of the report (including the requirement that the form be notarized) will constitute a failure to submit sworn payroll information as required by the Department.

7.1.1.2.4 An employer shall not, at any time during the project, pay less than the prevailing rate of wages for each hour worked, regardless of the rate of pay being paid at any other time.

7.1.1.2.5 An employer shall not pay less than the prevailing rate of wages by docking pay, docking time, or deducting pay for any purpose unless provided for by law including the Wage Payment and Collection Act of the State of Delaware (19 Del.C. §1107).

7.1.1.2.6 A person shall not, either for himself/herself or any other person, request, demand, or receive, either before or after an employee is engaged, that such employee pay back, return, donate, contribute, or give any part or all of said employee's wages, salary, or thing of value, to any person, upon the statement, representation, or understanding that failure to comply with such request or demand will prevent such employee from procuring or retaining employment. This paragraph does not apply to any agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization as permitted by law.

7.1.1.2.7 A person shall not, directly or indirectly, aid, request, or authorize any person to sign a release for any claim of wages with the intent to avoid payment of the prevailing wage rates.

7.1.1.3 Keep the following records for a period of three years:

7.1.1.3.1 The name and address of each employee;

7.1.1.3.2 The social security number of each employee;

7.1.1.3.3 A daily log for each individual employed upon the site of construction. The log must list (in general terms) the tasks performed by each employee and the amount of time spent performing each task. (Examples, “hung drywall”, “wired lighting fixtures”, etc.);

7.1.1.3.4 Each employee's basic hourly rate of pay (If an employee performs public project work in more than one trade, the employer's record must reflect the hourly rate paid for each type of work performed; If an employee performs both prevailing wage work and non-prevailing wage work, the records must reflect the rates paid for each.)

7.1.1.3.5 The number of hours worked in each occupation on the project in the applicable pay schedule, the number of hours worked in each day, and the total number of hours worked each week;

7.1.1.3.6 The amount of wages paid each employee;

7.1.1.3.7 The amount of wages paid each employee as fringe benefit payments;

7.1.1.3.8 The amount of any deductions withheld from each employee's wages; and

7.1.1.3.9 An accurate description of the nature of the deductions withheld from each employee's wages. (Fringe benefit deductions must be supported by a written fringe benefit policy as required by the Wage Payment and Collection Act.)
7.1.2 Investigation. A complaint may be filed with the Department by any employee upon a public project or any interested party. The complaint shall be in writing. Upon receipt of a complaint or upon its own motion the Department shall initiate an investigation.

7.1.2.1 The Department shall notify the employer that a complaint has been filed and/or that an investigation has been initiated. The Department may request (or subpoena, if necessary) records, documents, or testimony necessary to make a determination as to the validity of the complaint or the employer's compliance with the law.

7.1.2.2 Upon finding that an employer has not paid or is not paying the correct prevailing wage rates, the Department of Labor shall notify the employer of the violations by certified mail and make an effort to obtain compliance.

7.1.2.3 Upon failure to obtain compliance within fifteen (15) days of receipt of said certified mail, the Department may direct the contracting agency and/or the prime contractor to withhold payments to the employer (in an amount equal to the prevailing wage deficiencies, as determined by the Department) which are to be remitted to the Department for distribution upon resolution of the matter. In addition, the Secretary may terminate all rights of the employer to proceed with the work under the contract and the employer shall be responsible for all damages resulting therefrom.

7.1.2.4 If the dispute between the Department and the employer pertains to the classification of workers as determined by the Office of Labor Law Enforcement, the determination shall be reviewable by the Secretary or his/her designee and shall be reversed only upon a finding of abuse of discretion. Such appeals from the Office of Labor Law Enforcement's decision must be made in writing and must be received by the Secretary within fifteen (15) days from receipt of the Department's certified letter.

7.1.3 Hearings. A hearing shall be held only in cases involving the termination of rights to proceed with the work under the public construction contract.

7.1.4 Hearing Practices and Procedures.

7.1.4.1 Scope of Rules. These rules shall govern the conduct of hearings initiated by the Department of Labor pursuant to 29 Del.C. §6960(d) to terminate all rights of the contractor or subcontractor to proceed with work under a public construction contract for failure to pay prevailing wage rates.

7.1.4.2 Initiation of Hearing. The Secretary of Labor may initiate a hearing by notifying the contractor or subcontractor by registered mail that said contractor or subcontractor is alleged to have violated 29 Del.C. §6960. The notice shall give 20 days prior notice to all parties as follows:

7.1.4.2.1 The notice shall describe the subject matter of the proceedings;
7.1.4.2.2 The notice shall give the date, time and place the hearing will be held;
7.1.4.2.3 The notice shall cite the law or regulation giving the Department authority to act;
7.1.4.2.4 The notice shall inform the party of his/her right to present evidence, to be represented by counsel, and to appear personally or by other representative; and
7.1.4.2.5 The notice shall inform the parties that the Department will reach its decision based upon the evidence received.

7.1.4.3 Conduct of Hearing.

7.1.4.3.1 The hearing may be conducted by the Secretary of Labor or by a hearing officer designated for that purpose by the Secretary.

7.1.4.3.2 In connection with such hearing, the Secretary or hearing officer may:

7.1.4.3.2.1 Issue subpoenas for witnesses and other sources of evidence, either on the Department's initiative or at the request of any party;
7.1.4.3.2.2 Administer oaths to witnesses;
7.1.4.3.2.3 Exclude plainly irrelevant, immaterial, insubstantial, cumulative and privileged evidence;
7.1.4.3.2.4 Limit unduly repetitive proof, rebuttal and cross-examination;
7.1.4.3.2.5 Hold prehearing conferences for the settlement or simplification of issues by consent, for the disposal of procedural requests or disputes and to regulate and to expedite the course of the hearing.

7.1.4.3.3 The conduct of hearing shall not be bound by technical rules of evidence pursuant to 19 Del.C. 105(8).
7.1.4.3.4 The burden of proof shall be—upon the Department. (If the records maintained by the employer do not provide sufficient information to determine the exact amount of wages owed, the Department may make a determination based on available evidence.)

7.1.4.3.5 A record from which a verbatim transcript can be prepared shall be made of all hearings in contested cases. Transcripts shall be made at the request and expense of the requesting party.

7.1.4.4 Proposed Orders.

7.1.4.4.1 Whenever a hearing officer presides over a hearing (s)he shall prepare a proposed order for the consideration of the Secretary which shall include:

7.1.4.4.1.1 A brief summary of the evidence and recommended findings of fact based upon the evidence;
7.1.4.4.1.2 Recommended conclusions of law; and
7.1.4.4.1.3 Recommended decision.

7.1.4.4.2 When the proposed order is submitted to the Secretary, a copy shall be delivered to each of the other parties who shall have 10 days to submit in writing to the Secretary exceptions, comments and arguments respecting the proposed order.

7.1.4.5 Record. With respect to each case, all notices, correspondence between the agencies and the parties, all exhibits, documents in testimony admitted into evidence and all recommended orders, summary of evidence and findings of all interlocutory and final orders of the agency shall be included in the agency's record of the case and shall be retained by the agency for three years.

7.1.4.6 Decision; Final Order.

7.1.4.6.1 The Secretary shall make his/her decision based upon the entire record of the case and upon summaries and recommendations of the hearing officer.

7.1.4.6.2 Every case decision of the Secretary shall be incorporated in a final order which shall include, where appropriate:

7.1.4.6.2.1 A brief summary of the evidence;
7.1.4.6.2.2 Findings of fact based upon the evidence;
7.1.4.6.2.3 Conclusions of law;
7.1.4.6.2.4 Any other conclusion required by the law or the Department of Labor;
7.1.4.6.2.5 A concise statement of the Department of Labor's determination or action on the case.

7.1.4.6.3 Every final order shall be authenticated by the signature of the Secretary.

7.1.4.6.4 Every final order shall immediately be mailed or delivered to each party, to the contracting agency, and each other person requesting it.

7.1.4.6.5 Every final order may be amended or modified by the same procedure used for the initial adoption of the order.

7.1.4.7 Informal Disposition. Informal disposition may be made of any matter set for hearing by stipulation, agreed settlement, consent order, or default.

1 DE Reg. 519 (11/1/97)

8.0 Subsequent Modification of Regulations

The Secretary may, upon his/her own motion or upon the written request of any interested person setting forth reasonable grounds therefore, revoke or modify these regulations, after an opportunity has been given to interested persons to present their views on proposed changes. These regulations shall take effect in accordance with the requirements of the Administrative Procedures Act which is found in 29 Del.C. Ch. 101.
CLASSIFICATION OF WORKERS
UNDER
DELWARE’S
PREVAILING WAGE LAW

STATE OF DELAWARE
DEPARTMENT OF LABOR
OFFICE OF LABOR LAW ENFORCEMENT
225 CORPORATE BLVD., STE 104
NEWARK, DE 19702
(302) 451-3423

Adopted: April 3, 1992
Amended: July 1, 1993
Amended: September 15, 1993
Amended: December 28, 1994
Amended: August 15, 1996
Amended: September 15, 1997
Amended: July 10, 1998
Amended: June 24, 1999
Amended: July 11, 2001
Amended: October 30, 2003
Edited February 9, 2009
Amended February 12, 2013
Last Edited: February 12, 2013
Amended/Edited: July 31, 2014
Amended/Edited: October 8, 2014
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Trade</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos Worker</td>
<td>3</td>
</tr>
<tr>
<td>Boilermaker</td>
<td>3-4</td>
</tr>
<tr>
<td>Bricklayer</td>
<td>4-5</td>
</tr>
<tr>
<td>Carpenter</td>
<td>5-6</td>
</tr>
<tr>
<td>Cement Finisher</td>
<td>6-7</td>
</tr>
<tr>
<td>Electrical Line Worker</td>
<td>7</td>
</tr>
<tr>
<td>Electrician</td>
<td>7-8</td>
</tr>
<tr>
<td>Elevator Constructor</td>
<td>8</td>
</tr>
<tr>
<td>Glazier</td>
<td>8</td>
</tr>
<tr>
<td>Insulator</td>
<td>8-9</td>
</tr>
<tr>
<td>Ironworker</td>
<td>9</td>
</tr>
<tr>
<td>Laborer</td>
<td>10-12</td>
</tr>
<tr>
<td>Millwright</td>
<td>12</td>
</tr>
<tr>
<td>Painter</td>
<td>13</td>
</tr>
<tr>
<td>Pile Driver</td>
<td>13</td>
</tr>
<tr>
<td>Plasterer</td>
<td>14-15</td>
</tr>
<tr>
<td>Plumber/Pipefitter/Steamfitter</td>
<td>15-16</td>
</tr>
<tr>
<td>Power Equipment Operator</td>
<td>16</td>
</tr>
<tr>
<td>Roofer – Composition</td>
<td>16</td>
</tr>
<tr>
<td>Roofer – Shingle, Slate and Tile</td>
<td>17</td>
</tr>
<tr>
<td>Sheet Metal Worker</td>
<td>17-18</td>
</tr>
<tr>
<td>Soft Floor Layer</td>
<td>18</td>
</tr>
<tr>
<td>Sprinkler Fitter</td>
<td>18</td>
</tr>
<tr>
<td>Terrazzo/Marble/Tile Setter</td>
<td>19</td>
</tr>
<tr>
<td>Terrazzo/Marble/Tile Finisher</td>
<td>20-21</td>
</tr>
<tr>
<td>Truck Driver</td>
<td>21</td>
</tr>
</tbody>
</table>
ASBESTOS WORKER

Removes asbestos from ceilings, walls, beams, boilers, and other structures, following hazardous waste handling guidelines: Removes asbestos pipes. Assembles scaffolding and seals off work area, using plastic sheeting and duct tape. Positions mobile decontamination unit or portable showers at entrance of work area. Builds connecting walkway between mobile unit or portable showers and work area, using handtools, lumber, nails, plastic sheeting, and duct tape. Positions portable air evacuation and filtration system inside work area. Sprays chemical solution over asbestos covered surfaces, using tank with attached hose and nozzle, to soften asbestos. Cuts and scrapes asbestos from surfaces, using knife and scraper. Shovels asbestos into plastic disposal bags and seals bags, using duct tape. Cleans work area of loose asbestos, using vacuum, broom, and duct tape. Places asbestos in disposal bags and seals bags, using duct tape. Dismantles scaffolding and temporary walkway, using handtools, and places plastic sheeting and disposal bags into transport bags. Seals bags, using duct tape, and loads bags into truck.

BOILERMAKER

Assembles, analyzes defects in, and repairs boilers, pressure vessels, tanks, and vats in field, following blueprints and using handtools and portable power tools and equipment: Locates and marks reference points for columns or plates on foundation, using master straightedge, squares, transit, and measuring tape, and applying knowledge of geometry. Attaches rigging or signals crane operator to lift parts to specified position. Aligns structures or plate sections to assemble boiler frame, tanks, or vats, using plumb bobs, levels, wedges, dogs, or turnbuckles. Hammers, flame- cuts, files, or grinds irregular edges of sections or structural parts to facilitate fitting edges together. Bolts or arc-welds structures and sections together. Positions drums and headers into supports and bolts or welds supports to frame. Aligns water tubes and connects and expands ends to drums and headers, using tube expander. Bells, beads with power hammer, or welds tube ends to ensure leak proof joints. Bolts or welds casing sections, uptakes, stacks, baffles, and such fabricated parts as chutes, air heaters, fan stands, feeding tube, catwalks, ladders, coal hoppers and safety hatch to frame, using wrench. Installs manholes, handholes, valves, gauges, and feedwater connection in drums to complete assembly of water tube boilers. Assists in testing assembled vessels by pumping water or gas under specified pressure into vessel and observing instruments for evidence of leakage. Repairs boilers or tanks in field by unbolting or flame cutting defective sections or tubes, straightening plates, using torch or jacks, installing new tubes, fitting and welding new sections and replacing worn lugs on bolts. May rivet and caulk sections of vessels, using pneumatic riveting and caulking hammers. May line firebox with refractory brick and asbestos rope and blocks. May fabricate such parts as stacks, uptakes, and chutes to adapt boiler to premises in which it is installed.
Assembles boilers, tanks, vats, and pressure vessels according to blueprint specifications, using power tools and handtools: Reads blueprint to determine location and relationship of parts. Connects firetubes to heads or watertubes to drums and headers of boilers, by expanding and belling ends, using tube expander and beading ends, using power hammer. Drills and taps holes for installation of studs, using portable drill. Tightens bolts to assemble frames, using hand or power wrenches. Mounts casings of watertube boilers, or attaches davit heads, burners, or furnace casing to firetube boilers, using wrenches. Bolts or screws accessories, such as manholes, handholes, fans, gauges, and valves to vessel, using handtools or power wrenches. Replaces defective parts, using power wrenches, prying bars, or handtools. May install and repair refractory brick. May thread and install stay bolts, using pipe wrench and dies. May remove and replace rivets and caulk seams to repair riveted shells and structures, using pneumatic chisel, riveter, and caulking hammer. May cut out defective parts, using acetylene torch.

**BRICKLAYER**

Lays building materials, such as brick, structural tile, and concrete cinder, glass, gypsum, and terra cotta block to construct or repair walls, partitions, arches, sewers, and other structures: Lays brick pavers for sidewalks. Measures distance from reference points and marks guidelines on working surface to lay out work. Spreads soft bed (layer) of mortar that serves as base and binder for block, using trowel. Applies mortar to end of block and positions block in mortar bed. Taps block with trowel to level, align, and embed in mortar, allowing specified thickness of joint. Removes excess mortar from face of block, using trowel. Finishes mortar between brick with pointing tool or trowel. Breaks bricks to fit spaces too small for whole brick, using edge of trowel or brick hammer. Determines vertical and horizontal alignment of courses, using plumb bob, gaugeline (tightly stretched cord), and level. Fastens brick or terra cotta veneer to face of structures, with tie wires embedded in mortar between bricks, or in anchor holes in veneer brick. May weld metal parts to steel structural members. May apply plaster to walls and ceiling using trowel, to complete repair work.

Lays firebrick and refractory tile to build, rebuild, reline, or patch high-temperature or heating equipment, such as boilers, ovens, furnaces, converters, cupolas, ladles, and soaking pits, according to job orders and blueprints: Lays out work, using chalklines, plumb bobs, tapes, squares, and levels. Calculates angles and courses for building walls, arches, columns, corners and bottoms. Removes burned or damaged brick and cleans surface of setting, using sledgehammer, pry bar, pneumatic chipping gun, scraper and wire brush. Cuts firebrick or refractory materials to size, using brick hammer or powered abrasive saw with refractory or firebrick blade. Spreads fire-clay mortar over brick with trowel and lays brick in place. Spreads or sprays refractories over exposed bricks to protect bricks against deterioration by heat, using trowel or spray gun. Positions or bends special frame or hanger over casings to lay arches. Cuts, notches, or drills openings to provide outlets, pyrometer mountings, brackets and heating elements, using handtools. Patches or replaces firebrick linings of ladles and furnace tap holes. Constructs refractory forms for controlling quantity and flow of molten materials from furnace to rolling machines. May replace bolts, brackets, and heating elements, repair coke oven doors, weld cracks or holes in shell, or perform other repairs.
May pack insulation into shells and frames to insulate heating equipment, such as furnaces, boilers, and ovens. Sets stone to build stone structures, such as piers, walls and abutments, or lays walks, curbstones, or special types of masonry, such as alberene (acid-resistant soapstone for vats, tanks, and floors), using mason’s tools: Shapes stone preparatory to setting, using chisel hammer, and other shaping tools. Spreads mortar over stone and foundation with trowel and sets stone in place by hand or with aid of crane. Aligns stone with plumbline and finishes joints between stone with pointing trowel. May spread mortar along mortar guides to ensure joints of uniform thickness. May clean surface of finished wall to remove mortar, using muriatic acid and brush. May set cut and dressed ornamental and structural stone in buildings.

CARPENTER

Constructs, erects, installs, and repairs structures and fixtures of wood, plywood, and wallboard, using carpenter’s handtools and power tools, and conforming to local building codes: Studies blueprints, sketches, or building plans for information pertaining to type of material required, such as lumber or fiberboard, and dimensions of structure or fixture to be fabricated. Selects specified type of lumber or other materials. Prepares layout, using rule, framing square, and calipers. Marks cutting and assembly lines on materials, using pencil, chalk, and marking gauge. Shapes materials to precise measurements, using saws, chisels, and planes. Assembles cut and shaped materials and fastens them together with nails, dowel pins, or glue. Verifies trueness of structure with plumb bob and carpenter’s level. Erects framework for structures and lays subflooring. Builds stairs and lays out and installs partitions and cabinet work. Covers subfloor with building paper to keep out moisture and lays hardwood, parquet, and wood-strip-block floors by nailing floors to subfloor or cementing them to mastic or asphalt base. Applies shock-absorbing, sound-deadening, and decorative paneling to ceilings and walls. Fits and installs prefabricated window frames, doors, doorframes, weather stripping, interior and exterior trim, and finish hardware, such as locks, letterdrops, and kick plates. Constructs forms and chutes for pouring concrete. Erects scaffolding and ladders for assembling structures above ground level. May weld metal parts to steel structural members. Installs insulation (not sprayed urethane or polyurethane) in connection with carpentry work. Builds rough wooden structures, such as concrete forms with stakes, pins, wedges, nails, screws, zip ties, wire or other bonding materials, including insulated concrete form systems (ICF). Builds scaffolds, tunnel and sewer supports, and temporary frame shelters, according to sketches, blueprints, or oral instructions: Examines specifications to determine dimensions of structure. Measures boards, timbers, or plywood, using square, measuring tape, and ruler and marks cutting lines on materials, using pencil and scriber. Saws boards and plywood panels to required sizes. Nails cleats (braces) across boards to construct concrete-supporting forms. Braces forms in place with timbers, tie rods, and anchor bolts, for use in building concrete piers, footings, and walls. Erects chutes for pouring concrete. Cuts and assembles timbers to build trestles and cofferdams. Builds falsework to temporarily strengthen, protect, or disguise buildings undergoing construction. Erects scaffolding for buildings and ship structures and installs ladders, handrails, walkways, platforms, and gangways. Installs door and window bucks (rough frames in which finished frames are inserted) in designated positions in building framework, and braces them with boards nailed to framework. Installs subflooring in buildings. Nails plaster grounds (wood or metal strips) to studding to provide guide for plasterer. Fits and nails sheathing (first covering of boards) on outer walls and roofs of buildings. Setting and driving of wooden fence posts.
Plans gypsum drywall installations, erects metal framing and furring channels for fastening drywalls, and installs drywall to cover walls, ceilings, soffits, shafts, and movable partitions in residential, commercial, and industrial buildings: Reads blueprints and other specifications to determine method of installation, work procedures, and material, tool, and work aid requirements. Lays out reference lines and points for use in computing location and position of metal framing and furring channels and marks position for erecting metalwork, using chalkline. Measures, marks, and cuts metal runners, studs, and furring channels to specified size, using tape measure, straightedge and hand-and portable power-cutting tools. Secures metal framing to walls and furring channels to ceilings, using hand and portable power tools. Measures and marks cutting lines on drywall, using square, tape measure, and marking devices. Scribes cutting lines on drywall, using straightedge and utility knife and breaks board along cut lines. Fits and fastens board into specified position on wall, using screws, hand or portable power tools, or adhesive. Cuts openings into board for electrical outlets, vents or fixtures, using keyhole saw or other cutting tools. Measures, cuts, assembles and installs metal framing and decorative trim for windows, doorways, and vents. Fits, aligns, and hangs doors and installs hardware, such as locks and kickplates.

Installs plasterboard or other wallboard to ceiling and interior walls of building, using handtools and portable power tools: Installs horizontal and vertical metal or wooden studs for attachment of wallboard on interior walls, using handtools. Cuts angle iron and channel iron to specified size, using hacksaw, and suspends angle iron grid and channel iron from ceiling, using wire. Scribes measurements on wallboard, using straightedge and tape measure, and cuts wallboard to size, using knife or saw. Cuts out openings for electrical and other outlets, using knife or saw. Attaches wallboard to wall and ceiling supports, using glue, nails, screws, hammer, or powered screwdriver. Trims rough edges from wallboard to maintain even joints, using knife. Nails prefabricated metal pieces around windows and doors and between dissimilar materials to protect drywall edges. May remove plaster, drywall, or paneling during renovation project, using crowbar and hammer. Installs metal molding at corners in lieu of sealant and tape. The installation of exterior wall panels, including but not limited to panels made of metal, aluminum, vinyl, wood, or any other material. In connection with exterior wall panels, the installation of any insulation or other underlayment materials that are installed in connection with such wall panels, as well as any connections used to secure said panels to the structure or any building, window and door mounts and trim, exterior penetrations in any panels, and any sealant or waterproofing materials related to exterior wall panels.

' Note: Installation of forms is also found in other classifications relating to other trades.

CEMENT FINISHER

Smoothes and finishes surfaces of poured concrete floors, walls, sidewalks, or curbs to specified textures, using handtools or power tools, including floats, trowels, and screeds: Signals concrete deliverer to position truck to facilitate pouring concrete. Moves discharge chute of truck to direct concrete into forms. Spreads concrete into inaccessible sections of forms, using rake or shovel. Levels concrete to specified depth and workable consistency, using hand held screed and floats to bring water to surface and produce soft topping. Smoothes and shapes surfaces of freshly poured concrete, using straightedge and float or power screed. Finishes concrete surfaces, using power trowel, or wets and rubs concrete with abrasive stone to impart finish. Prepares cement surfaces by using a steel shotblaster, scarifier or diamond grinder.
Removes rough or defective spots from concrete surfaces, using power grinder or chisel and hammer, and patches holes with fresh concrete or epoxy compound. Molds expansion joints and edges, using edging tools, jointers, and straight edge.

May sprinkle colored stone chips, powdered steel, or coloring powder on concrete to produce prescribed finish. May produce rough concrete surface, using broom. May mix cement, using hoe or concrete-mixing machine. Mixes and applies epoxy to cement. May direct subgrade work, mixing of concrete.

**ELECTRICAL LINE WORKER**

Installs, maintains, repairs and replaces transmission and distribution power lines and circuits to conduct electrical energy outside of isolated plants and the property lines of any given property, but not electric signs, and not street electrical decorations, except when messenger or guy wire is necessary for support and when fed and controlled from the street. Directs workers in installing light poles or tower equipment, and determines whether light poles or tower equipment are properly aligned. Climbs poles and installs necessary hardware, including insulators, voltage regulators, capacitors or sectionalizers. Strings wire conductors between erected poles. Splices, solders, and insulates conductors and related wiring to join sections of power lines and, to connect transformers and electrical accessories. Constructs and installs ground wires and/or ground rods, guy wires and crossarms, including installing a brace for crossarm if needed. Installs footings for tower, if necessary.

Installs, maintains, repairs and replaces traffic signals. Assembles poles and other hardware, as well as the lighting fixture or traffic light. After the fixture is attached on the pole, directs workers in placing the pole. When the pole is set, attaches the pole with anchor bolts and then pulls and terminates cables. Cuts sensor loops in the asphalt and places sensors in the road for traffic signals. Programs control cabinets and after installation is complete, connects and tests power.

**ELECTRICIAN**

Plans layout, installs, and repairs wiring (low voltage and high voltage*), electrical fixtures, apparatus, and control equipment, including fiberoptic systems, alarm systems and telecommunication equipment*: Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes. Prepares sketches showing location of wiring and equipment, or follows diagrams or blueprints, ensuring that concealed wiring is installed before completion of future walls, ceilings, and flooring. Measures, cuts, bends, threads, assemblies, and installs electrical conduit, using tools, such as hacksaw, pipe threader, and conduit bender. Drills holes in concrete for the placement of electrical wiring. Installs pull wire in empty conduit. Pulls wiring through conduit. Splices wires by stripping insulation from terminal leads, using knife or pliers, twisting or soldering wires together, and applying tape or terminal caps. Connects wiring to lighting fixtures and power equipment, using handtools. Installs control and distribution apparatus, such as switches, relays, and circuit-breaker panels, fastening in place with screws or bolts, using handtools and power tools. Connects power cables to equipment, such as electric range or motor, and installs grounding leads. Lays PVC pipe for main feed electric line.
Tests continuity of circuit to ensure electrical compatibility and safety of components, using testing instruments, such as ohmmeter, battery and buzzer, and oscilloscope. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement.

'This is added as a clarification. These tasks have always been included within the description of tasks performed by Electricians.'

**ELEVATOR CONSTRUCTOR**

Assembles and installs electric and hydraulic freight and passenger elevators, escalators, and dumbwaiters, determining layout and electrical connections from blueprints: Studies blueprints and lays out location of framework, counterbalance rails, motor pump, cylinder, and plunger foundations. Drills holes in concrete or structural steel members with portable electric drill. Secures anchor bolts or welds brackets to support rails and framework, and verifies alignment with plumb bob and level. Cuts prefabricated sections of framework, rails, and other elevator components to specified dimensions, using acetylene torch, power saw, and disc grinder. Installs cables, counterweights, pumps, motor foundations, escalator drives, guide rails, elevator cars, and control panels, using handtools. Connects electrical wiring to control panels and electric motors. Installs safety and control devices. Positions electric motor and equipment on top of elevator shaft, using hoists and cable slings.

**GLAZIER**

Installs glass in windows, skylights, store fronts, and display cases, or on surfaces, such as building fronts, interior walls, ceilings, and tabletops: Marks outline or pattern on glass, and cuts glass, using glasscutter. Breaks off excess glass by hand or with notched tool. Fastens glass panes into wood sash with glazier's points, and spreads and smoothes putty around edge of panes with knife to seal joints. Installs mirrors or structural glass on building fronts, walls, ceilings, or tables, using mastic, screws, or decorative molding. Bolts metal hinges, handles, locks, and other hardware to prefabricated glass doors. Sets glass doors into frame and fits hinges. May install metal window and door frames into which glass panels are to be fitted. May press plastic adhesive film to glass or spray glass with tinting solution to prevent light glare. May install stained glass windows. May assemble and install metal-framed glass enclosures for showers.

**INSULATOR**

Applies insulating material*, including closed cell spray foam applied with airless spray machine to exposed surfaces of structures, such as air ducts, hot and cold pipes, storage tanks, and cold storage rooms; Reads blueprints and selects required insulation material (in sheet, tubular, or roll form), such as fiberglass, foam rubber, styrofoam, cork, or urethane, based on material's heat retaining or excluding characteristics. Prepares and applies fire stopping materials. Brushes adhesives on or attaches metal adhesive-backed pins to flat surfaces as necessary to facilitate application of insulation material.

Measures and cuts insulation material to specified size and shape for covering flat or round surfaces, using tape measure, knife, or scissors.
Fits, wraps, or attaches required insulation material around or to structure, following blueprint specifications. Covers or seals insulation with preformed plastic covers, canvas strips, sealant, or tape to secure insulation to structure, according to type of insulation used and structure covered, using staple gun, trowel, paintbrush, or caulking gun.

' Note: Installation of insulation is also found in other classifications relating to other trades.

IRONWORKER

Performs any combination of following duties (working as a member of a crew) to raise, place, and unite girders, columns, and other structural-steel, iron or fiber-reinforced polymers or other plastic members* to form completed structures or structure framework, and performs any combination of following duties to raise and place girders, columns, or other members when performing demolition of completed structures or structure framework if material will be reused: Sets up hoisting equipment for raising and placing members. Fastens members to cable of hoist, using chain, cable, or rope. Signals worker operating hoisting equipment to lift and place member. Guides member, using tab line (rope) or sides on member in order to guide it into position. Pulls, pushes, or pries members into approximate position while member is supported by hoisting device. Forces members into final position, using turnbuckles, crowbars, jacks, and handtools. Aligns rivet holes in member with corresponding holes in previously placed member by driving drift pins or handle of wrench through holes. Verifies vertical and horizontal alignment of members, using plumb bob and level. Bolts aligned members to keep them in position until they can be permanently riveted, bolted, or welded in place. Catches hot rivets tossed by rivet heater (heat treating) in bucket and inserts rivets in holes, using tongs. Bucks (holds) rivets while riveter, pneumatic, uses air-hammer to form heads on rivets. Cuts and welds members to make alterations, using oxyacetylene welding equipment.

Positions and secures steel bars in concrete forms to reinforce concrete: Determines number, sizes, shapes, and locations of reinforcing rods from blueprints, sketches, or oral instructions. Selects and places rods in forms, spacing and fastening them together, using wire and pliers. Cuts bars to required lengths, using hacksaw, bar cutters, or acetylene torch. May bend steel rods with handtools or rodbending machine. May reinforce concrete with wire mesh. May weld reinforcing bars together, using arc-welding equipment. Welds deck pans on a bridge, reinforcing supports for the concrete structure.

Erects, trims, and fits together by means of bolts and clamps, iron grills, grating, and special stairways. Erects ornamental enclosures and other ironwork not included in structural ironwork. Installs chain link fences. Fastens ironwork to walls of buildings by means of bolts, brackets or anchors. Fastens newel posts, balusters, and other parts of stairways by fastening to supports or embedding them in sockets. Forges, welds, drills, and cuts as needed. Erects precast wall panels and prestressed roof panels by bolting, clamping or welding at the bottom to footing and at the top to steel joints as needed.

' Hereinafter, “member/s” refers to structural steel, iron or fiber-reinforced polymers or other plastic material.
LABORER

Laborers may not assist mechanics in the performance of mechanic's work using tools peculiar to an established trade. Their work is to be confined to the following manual tasks:

- Digging and filling holes and trenches;
- Removes excess dirt or grout away by hand from augers as the auger progresses;
- Except as provided in other classifications, loading, unloading and stockpiling materials;
- Cleaning and sweeping;
- Driving stakes;
- Stripping forms;
- Ripping out material which is to be discarded;
- Ground clean-up of roof removal work. Performs roof removal work for demolition (Roof removal work for roof replacement is performed by Roofers);
- Clearing and grubbing;
- Flagging;
- Replacing painted lines on a road with tape strips, lays strips;
- Using a tool driven by compressed air, gas, or electric power to perform such work as breaking old pavement, loosening or digging hard earth, trimming bottom and sides of trenches, breaking large rocks, driving sheeting, chipping concrete, trimming or cutting stone, caulking steel plates, or compaction of earthen backfill;
- Tending a stationary or portable liquid asphalt kettle, starting fires (usually fuel oil) under the kettle, controlling heat applied to the kettle by regulating dials or burners, maintaining desired temperature in asphalt, regulating valves for discharge of asphalt from kettle; --Cleaning and pouring asphalt joints in concrete paving with nozzle or can; Taking care of asphalt kettle and kettle heaters;
- Operating control lever on non-powered asphalt spreader pulled behind dump truck, operating the screed on the back of an asphalt spreader;
- Distributing asphaltic road-building materials evenly over road surface by raking and brushing materials to correct thickness; may control straightedge to regulate width and depth of materials; directing "Asphalt Shovelers" when to add or take away material to fill low spots or to reduce high spots;
- Manually operating a stationary or portable batching scale that weighs out concrete materials; adjusting scales for required weight of the materials; operating controls that admit materials separately from storage hoppers to weighing bins; observing scales or indicators that show when proper amount of materials have been made; discharging materials from weighing bin into truck or other carrier or mixer; measuring materials by volume instead of weight;
- Assisting in the pouring of concrete by spreading concrete, cleaning and caring of cement mason's tools, mixing mortar used in the patching of concrete, and performing other tasks as may be directed by cement mason or plasterer; Mixing mortar for plasterers and delivering same to location where plasterer is working; cleaning and caring for tools and equipment used in the preparation and application of plaster;
- Operating a power driven chain saw to clear areas of timber; fells trees and sometimes cuts the fallen trees into short sections to facilitate their removal;
- Operating chippers and/or stump grinders;
- Operating a device used to burn holes, etc., through concrete; (this device consists of a consumable aluminum- magnesium rod inside a small iron pipe; oxygen is forced through the pipe under pressure, and the end of the assembly is lighted; the concrete is melted by the intense heat of the device);
• Driving self-propelled buggy to transport concrete from mixer or source of supply to place of deposit, operating levers to dump load, operating buggy by pushing or pulling by hand between mixer or other source to site of work;
• Operating small remote control vibrating compactor (such as a “whacker”) in trenches;
• Preparing the surfaces of concrete masonry which is not to be finished (using tools other than those normally used by "Cement Masons") by patching holes and broken corners, and removing high spots and defective concrete;
• Operating a power driven, hand guided, water cooled saw which is used to cut through slabs of concrete, except as otherwise provided elsewhere;
• Cuts brick, cinder block and concrete slabs using power abrasive saw, including hand-held, table or walk-behind saw;
• Operating a machine which applies asphalt or concrete along the edge of highways or parking aprons to form a small curb;
• Using a cutting torch for demolition work on steel or other metal structures;
• Cleaning and vacuuming heating and air conditioning ductwork that does not involve any dismantling, reassembling, cutting or bending sheet metal;
• Disassembling lead ductwork for demolition;
• Removal of sheet metal ductwork for demolition;
• Fitting together, aligning and grading metal road forms for holding concrete in place on road and street surfaces; dismantling, moving and cleaning forms after concrete hardens;
• Installing preformed wire baskets by tapping hooks along the edge of the basket to keep it in place on highway projects;
• Keeping stakes and stringline set in place out in front of trenching machine so that machine will cut ditch in correct location; setting stakes so that pipelayers can fine-grade ditch and measure from the batter board down to correct depth of ditch;
• Assisting operator and handling the equipment and directing the placing of concrete or mortar that is moved by pressure or pneumatic equipment, such as gunite; may fine-grade and place wire mesh at times; may perform other related semi-skilled duties.
• Assisting brickmasons, stonemason, and blockmasons by preparing mortar mix, either by hand or machine, delivering material to masons on scaffold, operating small material moving equipment such as power buggy, hoists, mortar mix pumps and other similar equipment; dismantles bricklayer scaffolds.
• Constructing a means of permanent access to water and sewer lines for maintenance purposes. Work consists of laying brick or concrete block starting form a concrete slab at bottom of ditch up to an approximate grade line near the surface of the ground; brick or block is laid in by eyesight and is normally not to a plumb line; chipped or culled brick can be used and quite often is; no effort may be made to keep mortar off the face of the brick and joints are not pointed; applies coating of concrete to interior and exterior surfaces, except where tools of the trade are involved, performs other related duties.
• Mechanically mixing mortar ingredients to proper consistency and delivering to mason on scaffold or at site of work; keeping materials supplied to mason and assisting according to directions of mason;
• Assembling large diameter metal culverts by bolting together semi-circular pieces of metal to form a complete circle, and bolting each section of this circle to similar sections which are placed adjacently, repeating these processes until the required length of culvert is formed.
On utility projects, laying tile, concrete, or corrugated metal pipe; receiving pipe lowered from top of trench; inserting spigot end of pipe into bell end of last laid pipe; adjusting pipe to line and grade; sealing joints with cement or other sealing compound;

Mixing plaster to be used in a machine which is designed to apply plaster to surfaces by means of a hose; handling and maintaining hose, placing and moving machine, and servicing and maintaining machine;

Cleaning, screening and feeding sand to hopper or pot of sandblasting machine;

Supervising and assisting in locating, loading, and firing blast holes for breaking up hard materials; enlarging bottom of drilled holes by discharging small quantities of explosives; inserting detonator in charge of explosive, attaching fuse or electric wires, the stick and detonator forming a primer, the discharge of which effects the discharge of the remainder of the explosive; charging hole by placing explosive, including stick that contains detonator, in hole and tamping with a pole; depressing handle of blasting machine or lights fuse to fire explosive; may use prima-cord or delay caps;

Carrying powder or other explosive to blaster or powderman and assisting by placing prepared explosive in hole, connecting lead wire to blasting machine, and performing other duties as directed;

Attaching and assisting in the installation of guardrails (other than guardrails on bridges), guardrail posts, informational signs, and metal fencing (including barbed wire and woven wire, excluding chain link and security fencing) which is used to define right of way, medians, or driving lanes or provide safety for such areas using small hand tools such as hammer and spud wrench;

Cleaning and preparing surfaces by the use of sandblasting equipment; sanding floors using buff machines or floor sanding machines;

Cleaning and dressing the slopes of roadway cuts and embankments while suspended by ropes or cables using hand tools as required;

Lowering hose-like flexible shaft of vibrator into newly poured concrete; starting power unit and holding shaft, allowing hammerhead on shaft to vibrate, thus compacting the concrete (air, electric, or gasoline operated vibrators are used);

Operating hand guided vibratory or impact compactor, adjusting levers, throttles and other devices necessary for operation;

Setting up and operating drilling mechanism that drills holes into concrete of rock; leveling machine by placing timbers under wheels; inserting and fastening drill steel in chuck; adjusting angle of drill tower and bolts into position; controlling drilling and speed of drill by moving levers;

Assisting in setting up drill, assorting drill steels, and inserting drill steel into drill chuck (as Wagon, Air Track, Drill and Diamond Drillers’ Tender - Outside); Lubricating drill;

Cleans and washes windows;

Handling the equipment and directing the placing of concrete or mortar 1 1/2” thickness or over that is moved by pneumatic equipment; may fine-grade; installing concrete around electrical conduits after pull-wires have been installed;

Performing landscaping duties including site development, soil preparation, fertilizing, the building of garden accessories, preparation for the installation of garden sprinkler systems; operating small walking type farm equipment; duties shall not include electrical work, fencing, concrete retaining walls, or other work which is generally performed by skilled craftsmen;

Assisting divers by performing tasks such as handling concrete hoses; handing tools to divers; delivering materials and monitoring two-way communication boxes; pouring epoxy material into piling encasements.
**MILLWRIGHT**

Installs machinery and equipment according to layout plans, blueprints, and other drawings in industrial establishment, using hoists, lift trucks, handtools, and power tools: Reads blueprints and schematic drawings to determine work procedures. Dismantles machines, using hammers, wrenches, crowbars, and other handtools. Moves machinery and equipment, using hoists, dollies, rollers, and trucks. Assembles and installs equipment, such as shafting, conveyors, and tram rails, using handtools and power tools. Constructs foundation for machines, using handtools and building materials, such as wood, cement, and steel.

Aligns machines and equipment, using hoists, jacks, handtools, squares, rules, micrometers, and plumb bobs. Assembles machines, and bolts, welds, rivets, or otherwise fastens them to foundation or other structures, using handtools and power tools. May operate engine lathe to grind, file, and turn machine parts to dimensional specifications. May repair and lubricate machines and equipment. May install robot and modify its program, using teach pendant. May perform installation and maintenance work as part of team of skilled trades workers.

**PAINTER**

Applies coats of paint, varnish, stain, enamel, or lacquer to decorate, waterproof and protect interior or exterior surfaces, trimmings, and fixtures of buildings and other structures, including decks for parking garages, roadway barriers and painting of roadway markings and lines with thermoplastic materials: Reads work order or receives instructions from supervisor regarding painting. Smooths surfaces, using sandpaper, brushes, or steel wool, and removes old paint from surfaces, using paint remover, scraper, wire brush, or blowtorch to prepare surfaces for painting. Fills nail holes, cracks, and joints with caulk, putty, plaster, or other filler, using caulking gun and putty knife. Selects premixed paints, or mixes required portions of pigment, oil, and thinning and drying substances to prepare paint that matches specified colors. Removes fixtures, such as pictures and electric switchcovers from walls prior to painting, using screwdriver. Spreads drop cloths over floors and room furnishings, and covers surfaces, such as baseboards, door frames, and windows with masking tape and paper to protect surfaces during painting. Paints surfaces, using brushes, spray gun, or paint rollers. Simulates wood grain, marble, brick, or tile effects. Applies paint with cloth, brush, sponge, or fingers to create special effects. Erects scaffolding or sets up ladders to perform tasks above ground level. May be designated according to type of work performed as Painter, Interior Finish (construction); Painter, Maintenance (any industry); or according to type of material used as Calciminer (construction); Varnisher (construction). May also hang wallpaper and fabrics. May wash surfaces prior to painting with mildew remover, using brush.

Seals joints between plasterboard or other wallboards to prepare wall surface for painting or papering: Mixes sealing compound by hand or with portable electric mixer, and spreads compound over joints between boards, using trowel, broadknife, or spatula. Presses paper tape over joint to embed tape into compound and seal joint, or tapes joint, using mechanical applicator that spreads compound and embeds tape in one operation. Spreads and smooths cementing material over tape, using trowel or floating machine to blend joint with wall surface. Sands rough spots after cement has dried. Fills cracks and holes in walls and ceiling with sealing compound. May countersink nails or screws below surface of wall prior to applying sealing compound, using hammer or screwdriver.

'This is added as a clarification. These tasks have always been included within the description of tasks performed by Painters.'
PILE DRIVER

Performs work involving pilings or sheeting of wood, concrete, steel or plastic on wharves, piers, docks, bulkheads, jetties, wooden bridges, ferry slips and pile foundations, including boring operations for the installation of auger cast piles. Sets up and tends all pile test loads. Performs any combination of the following duties in pile driving operations to raise and place wooden or concrete piles or steel sheeting: Sets up hoisting equipment for raising and placing wooden or concrete piles or steel sheeting sections to cable of hoist, using chain, cable or rope.

Signals worker operating hoisting equipment to lift and place the wooden or concrete pile or steel sheeting section. Guides wooden or concrete pile or steel sheeting section, using tab line (rope) or rides on pile or steel sheeting to guide it into position. Pulls, pushes or pries wooden or concrete pile or steel sheeting into place while pile or sheeting is supported by hoisting equipment. Dresses and caps the pilings which have been driven, and prepares them to receive the superstructure. Performs work in connection with shoring systems replacing sheeting (krings system and lagging). Installs tie-backs for the shoring system and tests shoring system.

Perform placement of rings, shores, bracing and jacking of all piles on the underpinning of buildings, bridges, railroads and all other underpinning operations. Handles, sets, secures, cuts and drills pre-cast piles and pile caps on bridges, piers, docks and wharves. Handles, sets, secures, cuts and drills pre-cast decking on piers, docks and wharves.

Repairs deteriorated pilings by installing a pile encasement.

PLASTERER

Applies coats of plaster to interior walls, ceilings, and partitions of buildings, to produce finished surface, according to blueprints, architect's drawings, or oral instructions, using handtools and portable power tools: Directs workers to mix plaster to desired consistency and to erect scaffolds. Spreads plaster over lath or masonry base, using trowel, and smoothes plaster with darby and float to attain uniform thickness. Sprays fireproof insulation onto steel beams. Applies scratch, brown, or finish coats of plaster to wood, metal, or board lath successively. Roughens undercoat with scratcher (wire or metal scraper) to provide bond for succeeding coats of plaster. Creates decorative textures in finish coat by marking surface of coat with brush and trowel or by spattering surface with pebbles. May install lathing. May mix mortar. May install guide wires on exterior surface of buildings to indicate thickness of plaster to be applied. May install precast ornamental plaster pieces by applying mortar to back of pieces and pressing pieces into place on wall or ceiling.

Molds and installs ornamental plaster panels and trim, and runs (casts) ornamental plaster cornices and moldings by either of following methods: (1) Spreads freshly mixed plaster on table or in forms with trowel when molding and installing ornamental trim. Shapes plaster by hand, using template and cuts trim to size after plaster has hardened.

Applies coat of plaster to wall and presses trim into position. (2) Nails wooden strips to wall and ceiling to serve as guide for template when casting (running) cornices or moldings. Applies plaster to wall or ceiling, using trowel. Pushes template over plaster, striking off excess plaster until desired shape and smoothness of molding is obtained.
Applies weatherproof, decorative covering of Portland cement or gypsum plaster to outside building surfaces, using handtools. Decorates final or finish coat by marking coat with sand, or with brush or trowel, or by spattering with small stones. May nail wire mesh, lath, or similar material to outside surfaces to serve as binding device to hold stucco in place. May apply stucco, using spray gun. May install guide wires on surface of buildings to indicate thickness of stucco to be applied.

PLUMBER/PIPEFITTER/STEAMFITTER

Lays out, assembles, installs, and maintains pipe systems, pipe supports, and related hydraulic and pneumatic equipment, for steam, hot water, heating, cooling, lubricating, sprinkling, and industrial production and processing systems, applying knowledge of system operation, and following blueprints: Unloads and handles material to be used by plumbers and pipefitters under this definition; Selects type and size of pipe, and related materials and equipment, such as supports, hangers, and hydraulic cylinders, according to specifications. Inspects work site to determine presence of obstructions and to ascertain that holes cut for pipe will not cause structural weakness. Plans installation or repair to avoid obstructions and to avoid interfering with activities of other workers. Cuts pipe, using saws, pipe cutter, hammer and chisel, cutting torch, and pipe cutting machine. Threads pipe, using pipe threading machine. Bends pipe, using pipe bending tools and pipe bending machine. Installs and maintains hydraulic and pneumatic components of machines and equipment, such as pumps and cylinders, using handtools. Installs and maintains refrigeration and air-conditioning systems, including compressors, pumps, meters, pneumatic and hydraulic controls, and piping, using handtools and power tools, and following specifications and blueprints. Increases pressure in pipe system and observes connected pressure gauge to test system for leaks. May weld pipe supports to structural steel members. Performs welds on steel casing for sanitary sewers. May operate machinery to verify repair. May modify programs of automated machinery, such as robots and conveyors, to change motion and speed of machine, using teach pendant, control panel, or keyboard and display screen of robot controller and programmable controller. May be designated Steam Fitter when installing piping systems that must withstand high pressure.

Assembles, installs, and repairs pipes, fittings, and fixtures of heating, water, and drainage systems, according to specification and plumbing codes: Studies building plans and working drawings to determine work aids required and sequence of installations. Inspects structure to ascertain obstructions to be avoided to prevent weakening of structure resulting from installation of pipe. Locates and marks position of pipe and pipe connections and passage holes for pipes in walls and floors, using ruler, spirit level, and plumb bob. Cuts openings in walls and floors to accommodate pipe and pipe fittings, using handtools and power tools. Cuts and threads pipe, using pipe cutters, cutting torch, and pipe-threading machine. Bends pipe to required angle by use of pipe-bending machine or by placing pipe over block and bending it by hand.

Assembles and installs valves, pipe fittings, and pipes composed of metals, such as iron, steel, brass, and lead, and nonmetals, such as glass, vitrified clay, and plastic, using handtools and power tools. Joins pipes by use of screws, bolts, fittings, solder, plastic solvent, heat fusion equipment and caulsks joints. Fills pipe system with water or air and reads pressure gauges to determine whether system is leaking.
Installs and repairs plumbing fixtures, such as sinks, commodes, bathtubs, water heaters, hot water tanks, garbage disposal units, dishwashers, and water softeners. Repairs and maintains plumbing by replacing washers in leaky faucets, mending burst pipes, and opening clogged drains. May weld holding fixtures to steel structural members.

Test, adjust and balance heating and cooling piping systems in commercial and industrial buildings using specialized tools and equipment to attain performance standards specified in system design. Adjusts flow control valves in piping to balance system, using hand tools such as pliers, screwdriver, and wrenches.

Work with balancing personnel to perform tests to see if the heating and cooling systems are operating to specifications and detect malfunctions in piping system component parts.

**POWER EQUIPMENT OPERATOR**

Operates Steel and Stone handling equipment in connection with erection; Operates cranes, machine-handling machinery, cable spinning machine, helicopters, backhoes, cableways, conveyor loader, drag lines, keystones, all types of shovels, derricks, trench shovels, trenching machines, pippin type backhoe, hoists, pavers, mucking machine, mucking machine, gradalls, front-end loaders, tandem scraper, drills (self-contained Drillmaster type), fork lift, motor patrols, batch plant with mixer, scraper and tournapull, rollers, spreaders, pan trucks, bulldozers, tractors, conveyors, pressure bokers, well drillers, ditch witch type trenched, concrete breaking machines, fine grade machines, seam pulverizing mixer, form line graders, road finishing machines, power boom, broom truck, street sweeper, seed spreader, grease truck (to provide fuel, lubrication and service for power equipment), wellpoints, compressors, pumps and machines similar to above. Sets up hollow stem auger equipment for attachment to crane. Included in this classification are mechanics for power equipment, tiremen on power equipment, asphalt plant engineers, maintenance engineer (power boat), firemen, oilers and deck hands (personnel boats), and grease truck helper.

**ROOFER – COMPOSITION**

Applies roofing materials, including insulation, underlayment, ice and water shield, felt paper, nailboard, vapor retarder, thermal layers, acoustic layers, waterproofing or protective materials in conjunction with the roof system, including metal roof systems. Applies low slope roof substrate materials used as vapor barrier, fireproofing, support or attachment surfaces for composition roof systems to the roof deck. Applies rigid insulation, including composite insulations having nailable surfaces bonded to the insulation, when used as components of low sloped roof systems or with waterproofing. Applies mineral aggregate, gravel, slag, ballast, pavers, protection boards, walkway pads and roof treads when used to surface or protect low slope composition roof systems or waterproofing. Installs base flashings, curb flashings and counter-flashings used to roof or waterproof intersecting surfaces on low slope roofs. Applies components of low slope composition roofing systems used to seal, coat and maintain the roof including roof cements, reinforcements, finishing and toppings. Applies spray-in-place foams such as urethane, polyurethane or polyisocyanurate and the coatings applied over them when used for roofing and waterproofing. Applies bituminous or asphaltic-based sheet, liquid, semi-liquid and/or pre-formed panels as necessary to waterproof low slope roofing system. Removes existing low slope composition roof materials in connection with the installation of a new composition roof at the same location. Removes existing sheet metal roofs and all associated components.
**ROOFER – SHINGLE, SLATE AND TILE**

Applies shingle, slate and tile roofing materials (including insulation incidental to the roof system) on steep slope roofs. Applies roofing felt, paper, membrane, and ice shield or vapor barrier as layer beneath shingle, slate and tile roofs. Aligns steep slope roofing material with roof edge and overlaps successive layers. Gauges distance of overlap with chalkline, gauge on shingling hatchet, or by lines on shingles. Fastens shingles to roof with asphalt, cement, or nails.

Cuts and punches holes in slate, tile, terra cotta or wood roofing shingles using punch and hammer. Applies rigid insulation, including composite insulation having nailable surfaces bonded to the insulation, to steep slope roofs where such insulation is related to the application of shingle, slate and/or tile roofing materials. May construct and install prefabricated roof sections to rafters.

Removes existing shingle, slate and/or tile roof materials in connection with the application of a new shingle, slate and/or tile roof at the same location.

**SHEET METAL WORKER**

Plans, lays out, fabricates, assembles, installs, and repairs sheet metal parts, equipment, and products, utilizing knowledge of working characteristics of metallic and nonmetallic materials, machining, and layout techniques, using handtools, power tools, machines, and equipment:

- Reads and interprets blueprints, sketches, or product specifications to determine sequence and methods of fabricating, assembling, and installing sheet metal products. Selects gauge and type of sheet metal, such as galvanized iron, copper, steel, or aluminum, or nonmetallic material, such as plastics or fiberglass, according to product specifications. Lays out and marks dimensions and reference lines on material, using scribers, dividers, squares, and rulers, applying knowledge of shop mathematics and layout techniques to develop and trace patterns of product or parts or using templates. Sets up and operates fabricating machines, such as shears, brakes, presses, forming rolls, and routers, to cut, bend, block and form, or straighten materials. Shapes metal material over anvil, block, or other form, using handtools. Trims, files, grinds, deburrs, buffs, and smoothes surfaces, using handtools and portable power tools.
- Welds, solders, bolts, rivets, clips, caulks, or bonds component parts to assemble products, using handtools, power tools, and equipment. Installs assemblies in supportive framework according to blueprints, using handtools, power tools, and lifting and handling devices. Installs standing-seam metal roofs (but not insulation and other roofing material — refer to definition for Roofer-Composition - installed in conjunction with metal roof systems. Installs aluminum fascia on roofs. Inspects assemblies and installation for conformance to specifications, using measuring instruments, such as calipers, scales, dial indicators, gauges, and micrometers. Repairs and maintains sheet metal products. May operate computer-aided-drafting (CAD) equipment to develop scale drawings of product or system. May operate laser-beam cutter or plasma arc cutter to cut patterns from sheet metal.

Installs sheet metal ductwork to facilitate the movement of air. Disassembly of existing sheet metal ductwork in connection with the installation of new sheet metal ductwork at the same location.
Cuts, patches, disassembles and reassembles ducts in duct-cleaning operations. Tests, adjusts, and balances heating, cooling, and ventilation systems in commercial and industrial buildings using specialized tools and test equipment to attain performance standards specified in system design. Studies system blueprints, specifications and performance data to determine configuration and purpose of system components, such as motors, pumps, fans, switches and ducts. Discusses systems malfunctions with users to isolate problems. Inspects systems to verify system compliance with plans and specifications and to detect malfunctions in system components parts. Adjusts system controls to settings recommended by vendor to prepare to perform tests. Tests performance of air systems, using specialized tools and test equipment, such as pitot tube, manometer, anemometer, velocimeter, tachometer, psychrometer, thermometer, to isolate problems and to determine where adjustments are necessary. Opens or closes louvers in system ductwork to balance system, using hand tools such as pliers, screwdrivers, or wrenches. Discusses system operations with users to verify that malfunctions have been corrected. Installs insulation (not sprayed urethane or polyurethane) incidental to sheet metal work.

**SOFT FLOOR LAYER**

Applies blocks, strips, or sheets of shock-absorbing, sound-deadening, or decorative covering to floors, walls, and cabinets: Disconnects and removes obstacles, such as appliances and light fixtures. Sweeps, scrapes, sands, or chips dirt and irregularities from base surfaces, and fills cracks with putty, plaster, or cement grout to form smooth, clean foundation. Measures and cuts covering materials, such as rubber, linoleum or cork tile, and foundation material, such as felt, according to blueprints and sketches, using rule, straightedge, linoleum knife, and snips. Spreads adhesive cement over floor to cement foundation material to floor for sound-deadening, and to prevent covering from wearing at board joints. Lays out centerlines, guidelines, and borderline on foundation with chalkline and dividers. Spreads cement on foundation material with serrated trowel. Lays covering on cement, following specified pattern. Presses tile into cement. Removes excess cement from joints between tile to clean finished surface, using damp cloth or cleaning compound. Rolls sheet wall covering with hand roller to press into cement. May soften area of floor covering with butane torch to fit materials around irregular surfaces. May lay carpet.

Applies decorative steel, aluminum, and plastic tile (known as soft tile to distinguish from ceramic tile) to walls and cabinets of bathrooms and kitchens: Measures surface to locate center points and draws horizontal and vertical guidelines through them. Brushes waterproof compound over plaster surfaces to seal pores. Spreads adhesive cement over wall, using trowel or broad knife. Positions tile on cement, following specified pattern. Presses tile into cement. Removes excess cement from joints between tile to clean finished surface, using damp cloth or cleaning compound. Rolls sheet wall covering with hand roller to press into cement. May wipe grout into joints of tile to seal them.
**SPRINKLER FITTER**

Installs and maintains all fire protection and fire control systems including the unloading, handling by hand, power equipment and installation of all piping or tubing, appurtenances and equipment pertaining thereto, including both overhead and underground water mains, fire hydrants and hydrant mains, standpipes and hose connections to sprinkler systems, sprinkler tank heaters, air lines and thermal systems used in connection with sprinkler and alarm systems, also all tanks and pumps connected thereto, also included shall be CO-2 and Cardox Systems, Dry Chemical Systems, Foam Systems, Halon and all other fire protection systems, the locating of and cutting or coring of all holes for piping and the setting of all sleeves and inserts required for the installation of the work.

**TERRAZZO/MARBLE/TILE SETTER**

Cuts, tools, and sets marble slabs in floors and walls of buildings and repairs and polishes slab previously set in buildings: Trims, faces, and cuts marble to specified size, using power sawing, cutting, and facing equipment and handtools. Drills holes in slab and attaches bracket. Spreads mortar on bottom of slab and on sides of adjacent slabs. Sets block in position, tamps it into place, and anchors bracket attachment with wire. Fills joints with grout. Removes excess grout from marble with sponge.

Cleans and bevels cracks or chips in slabs, using handtools and power tools.

Heats cracked or chipped area with blowtorch and fills defect with composition mastic that matches grain of marble. Polishes marble and other ornamental stone to high luster, using power tools or by hand.

Applies cement, sand, pigment, and marble chips to floors, stairways, and cabinet fixtures to attain durable and decorative surfacing according to specifications and drawings: Spreads roofing paper on surface of foundation. Spreads mixture of sand, cement, and water over surface with trowel to form terrazzo base. Cuts metal division strips and presses them into terrazzo base so that top edges form desired design or pattern and define level of finished floor surface. Spreads mixture of marble chips, cement, pigment, and water over terrazzo base to form finished surface, using float and trowel. Scatters marble chips over finished surface. Pushes roller over surface to imbed chips. Allows surface to dry, and pushes electric-powered surfacing machine over floor to grind and polish terrazzo surface. Grinds curved surfaces and areas inaccessible to surfacing machine, such as stairways and cabinet tops, with portable hand grinder. May precast terrazzo blocks in wooden forms.

Applies tile to walls, floors, ceilings, and promenade roof decks, following design specifications: Examines blueprints, measures and marks surfaces to be covered, and lays out work. Measures and cuts metal lath to size for walls and ceilings with tin snips. Tacks lath to wall and ceiling surfaces with staple gun or hammer. Spreads plaster base over lath with trowel and levels plaster to specified thickness, using screed. Spreads concrete on subfloor with trowel and levels it with screed. Spreads mastic or other adhesive base on roof deck using serrated spreader to form base for promenade tile. Cuts and shapes tile with tile cutters and biters. Positions tile and taps it with trowel handle to affix tile to plaster or adhesive base.
TERRAZZO/MARBLE/TILE FINISHER

Supplies and mixes construction materials for Marble Setter, applies grout, and cleans installed marble: Moves marble installation materials, tools, machines, and work devices to work areas. Mixes mortar, plaster, and grout, as required, following standard formulas and using manual or machine mixing methods. Moves mixed mortar or plaster to installation area, manually or using wheelbarrow. Selects marble slab for installation, following numbered sequence or drawings. Drills holes and chisels channels in edges of marble slabs to install metal wall anchors, using power drill and chisel. Bends wires to form metal anchors, using pliers, inserts anchors into drilled holes of marble slab, and secures anchors in place with wooden stake and plaster. Moves marble slabs to installation site, using dolly, hoist, or portable crane. Fills marble joints and surface imperfections with grout, using grouting trowel or spatula, and removes excess grout, using wet sponge. Grinds and polishes marble, using abrasives, chemicals, and manual or machine grinding and polishing techniques. Cleans installed marble surfaces, work and storage areas, installation tools, machinery, and work aids, using water and cleaning agents. Stores marble, installation materials, tools, machinery, and related items. May modify mixing, grouting, polishing, and cleaning methods and procedures, according to type of installation or materials. May repair and fill chipped, cracked, or broken marble pieces, using torch, spatula, and heat sensitive adhesive and filler. May secure marble anchors to studding, using pliers, and cover ends of anchors with plaster to secure anchors in place. May assist Marble Setter to saw and position marble. May erect scaffolding and related installation structures.

Supplies and mixes construction materials for Terrazzo Worker, applies grout, and finishes surface of installed terrazzo: Moves terrazzo installation materials, tools, machines, and work devices to work areas, manually or using wheelbarrow. Measures designated amounts of ingredients for terrazzo or grout, using graduated containers and scale, following standard formulas and specifications, and loads portable mixer, using shovel. Mixes materials according to experience and requests from Terrazzo Worker and dumps mixed materials that form base or top surface of terrazzo into prepared installation site, using wheelbarrow. Applies curing agent to installed terrazzo to promote even curing, using brush or sprayer. Grinds surface of cured terrazzo, using power grinders, to smooth terrazzo and prepare for grouting. Spreads grout across terrazzo to fill surface imperfections, using trowel. Fine grinds and polishes surface of terrazzo, when grout has set, using power grinders. Washes surface of polished terrazzo, using cleaner and water, and applies sealer, according to manufacturer's specifications, using brush. Installs grinding stone in power grinders, using handtools. Cleans installation site, mixing and storage areas, tools, machines, and equipment, using water and various cleaning devices. Stores terrazzo installation materials, machines, tools, and equipment. May modify mixing, grouting, grinding, and cleaning procedures according to type of installation or material used. May assist Terrazzo Worker to position and secure moisture membrane and wire mesh prior to pouring base materials for terrazzo installation.

May spread marble chips or other material over fresh terrazzo surface and press into terrazzo, using roller. May cut divider and joint strips to size as directed. May cut grooves in terrazzo stairs, using power grinder, and fill grooves with nonskid material.

Supplies and mixes construction materials for Tile Setter, applies grout, and cleans installed tile: Moves tiles, tilesetting tools, and work devices from storage area to installation site manually or using wheelbarrow. Mixes mortar and grout according to standard formulas and request from Tile Setter, using bucket, water hose, spatula, and portable mixer.
Supplies Tile Setter with mortar, using wheelbarrow and shovel. Applies grout between joints of installed tile, using grouting trowel. Removes excess grout from tile joints with wet sponge and scraps corners and crevices with trowel. Wipes surface of tile after grout has set to remove grout residue and polish tile, using nonabrasive materials. Cleans installation site, mixing and storage areas, and installation machines, tools, and equipment, using water and various cleaning tools. Stores tile setting materials, machines, tools, and equipment. May apply caulk, sealers, acid, steam, or related agents to caulk, seal, or clean installed tile, using various application devices and equipment. May modify mixing, grouting, grinding, and cleaning procedures according to type of installation or material used. May assist Tile Setter to position and secure metal lath, wire mesh, or felt paper prior to installation of tile. May cut marked tiles to size, using power saw or tile cutter. Restores, seals, rejuvenates tile and grout.

**TRUCK DRIVER**

Operates dumps, dumpsters, escort and pilot vehicles, flat body material trucks, form trucks, greasers (to provide fuel, lubrication and service for trucks) and steamers, panel truck, pick-ups, rubber-tired towing and pushing vehicles, A-frames, agitators or mixers, asphalt distributors, low-boys, semi-trailers, tandems, batch truck, euclid type or similar off-highway equipment, off-highway tandem back-dump, specialized earth moving equipment, twin engine equipment and double-hitched equipment, and equipment similar to above. This classification also includes truck mechanics.
GENERAL REQUIREMENTS

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
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
ARTICLE 1: GENERAL

1.1 CONTRACT DOCUMENTS

1.1.1 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 to an extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.1.2 Work including material purchases shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order. Any work performed or material purchases prior to the issuance of the Purchase Order is done at the Contractor’s own risk and cost.

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

1.2.1 For Public Works Projects financed in whole or in part by state appropriation the Contractor agrees that during the performance of this contract:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, sex, color, sexual orientation, gender identity or national origin.”

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

3.1 Schedule of Values: The successful Bidder shall within twenty (20) days after receiving notice to proceed with the work, furnish to the Owner a complete schedule of values on the various items comprising the work.
3.2 Subcontracts: Upon approval of Subcontractors, the Contractor shall award their Subcontracts as soon as possible after the signing of their own contract and see that all material, their own and those of their Subcontractors, are promptly ordered so that the work will not be delayed by failure of materials to arrive on time.

3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.

3.4 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, unless the Contract Documents give other specific instructions.

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

3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.

3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.

3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.

3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.

3.10 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.

3.11 STATE LICENSE AND TAX REQUIREMENTS

3.11.1 Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, "the Contractor shall furnish the Delaware Department of Finance within ten (10) days after entering into any contract..."
with a contractor or subcontractor not a resident of this State, a statement of total value of such contract or contracts together with the names and addresses of the contracting parties.”

3.12 The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.

3.13 During the contract Work, the Contractor and each Subcontractor, shall implement an Employee Drug Testing Program in accordance with OMB Regulation 4104 - “Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on “Large Public Works Projects”. “Large Public Works” is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.1 CONTRACT SURETY

4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

4.1.2 All bonds will be required as follows unless specifically waived elsewhere in the Bidding Documents.

4.1.3 Contents of Performance Bonds – The bond shall be in the form approved by the Office of Management and Budget. The bond shall be conditioned upon the faithful compliance and performance by the successful bidder of each and every term and condition of the contract and the proposal, plans, specifications, and bid documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid documents and the specifications, including the payment in full to every person furnishing materiel or performing labor in the performance of the Contract, of all sums of money due the person for such labor and materiel. (The bond shall also contain the successful bidder’s guarantee to indemnify and save harmless the State and the agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)

4.1.4 Invoking a Performance Bond – The agency may, when it considers that the interest of the State so requires, cause judgement to be confessed upon the bond.

4.1.5 Within twenty (20) days after the date of notice of award of contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate.

4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of two (2) years after the date of the Certificate for Final Payment. The Performance Bond shall guarantee the satisfactory completion of the Project and that the Contractor will make good any faults or defects in his work which may develop during the period of said guarantees as a result of improper or defective workmanship, material or apparatus, whether
furnished by themselves or their Sub-Contractors. The Payment Bond shall guarantee that the Contractor shall pay in full all persons, firms or corporations who furnish labor or material or both labor and material for, or on account of, the work included herein. The bonds shall be paid for by this Contractor. The Owner shall have the right to demand that the proof parties signing the bonds are duly authorized to do so.

4.2 FAILURE TO COMPLY WITH CONTRACT

4.2.1 If any firm entering into a contract with the State, or Agency that neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with this Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from pursuing additional remedies as otherwise provided by law.

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the State, for and from all claims of liability which is or may be the result of the successful Bidder’s actions during the performance of the Contract.

4.3.2 The purchase or nonpurchase of such insurance or the involvement of the successful Bidder in any legal or equitable defense of any action brought against the successful Bidder based upon work performed pursuant to the Contract will not waive any defense which the State, its agencies and their respective officers, employees and agents might otherwise have against such claims, specifically including the defense of sovereign immunity, where applicable, and by the terms of this section, the State and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

4.4 RIGHT TO AUDIT RECORDS

4.4.1 The Owner shall have the right to audit the books and records of a Contractor or any Subcontractor under any Contract or Subcontract to the extent that the books and records relate to the performance of the Contract or Subcontract.

4.4.2 Said books and records shall be maintained by the Contractor for a period of seven (7) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of seven (7) years from the date of final payment under the Subcontract.
ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

5.1.1 All contracts for the construction, reconstruction, alteration, or repair of any public building (not a road, street, or highway) shall be subject to the following provisions:

1. A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address (city or town and State only – street number and P.O. Box addresses not required) of the subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.

2. A Bid will not be accepted, nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:

   A. It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder’s firm.

   B. That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and

   C. That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.

5.1.2 The decision of the awarding Agency as to whether a Bidder who list itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders, and no action of any nature shall lie against any awarding agency or its employees or officers because of its decision in this regard.

5.1.3 After such a Contract has been awarded, the successful Bidder shall not substitute another Subcontractor for any Subcontractor whose name was set forth in the statement which accompanied the Bid without the written consent of the awarding Agency.

5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:

   A. Is unqualified to perform the work required.

   B. Has failed to execute a timely reasonable Subcontract.

   C. Has defaulted in the performance on the portion of the work covered by the Subcontract; or

   D. Is no longer engaged in such business.
5.1.5 Should a Bidder be awarded a contract; such successful Bidder shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.1.6 The Contractor may employ additional Subcontractors on the jobsite only after submitting a copy of the Subcontractor’s Employee Drug Testing Program to the Owner for approval. A Contractor or Subcontractor shall not commence work until the Owner has concluded its review and determined that the submitted Employee Drug Testing Program complies with OMB Regulation 104.

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

5.2.1 Should the Contractor fail to utilize any or all of the Subcontractors in the Contractor’s Bid statement in the performance of the Work on the public bidding, the Contractor shall be penalized in the amount of (project specific amount*). The Agency may determine to deduct payments of the penalty from the Contractor or have the amount paid directly to the Agency. Any penalty amount assessed against the Contractor may be remitted or refunded, in whole or in part, by the Agency awarding the Contract, only if it is established to the satisfaction of the Agency that the Subcontractor in question has defaulted or is no longer engaged in such business. No claim for the remission or refund of any penalty shall be granted unless an application is filed within one year after the liability of the successful Bidder accrues. All penalty amounts assessed and not refunded or remitted to the contractor shall be reverted to the State.

*one (1) percent of contract amount not to exceed $10,000

5.3 ASBESTOS ABATEMENT

5.3.1 The selection of any Contractor to perform asbestos abatement for State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

5.4.1 All Contracts shall conform with the standard established by the Delaware Architectural Accessibility Board unless otherwise exempted by the Board.
5.5 CONTRACT PERFORMANCE

5.5.1 Any firm entering into a Public Works Contract that neglects or refuses to perform or fails to comply with its terms, the Agency may terminate the Contract and proceed to award a new Contract or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond.

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

6.1 The Owner reserves the right to simultaneously perform other construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other Projects at the same site.

6.2 The Contractor shall afford the Owner and other Contractors reasonable opportunity for access and storage of materials and equipment, and for the performance of their activities, and shall connect and coordinate their activities with other forces as required by the Contract Documents.

ARTICLE 7: CHANGES IN THE WORK

7.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of Additions, Deletions, Modifications or Substitutions, with the Contract Sum and Contract completion date being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Professional, as the duly authorized agent, the Contractor, and the Owner.

7.2 The Contract Sum and Contract Completion Date shall be adjusted only by a fully executed Change Order.

7.3 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor, and the Architect. In all cases, this cost or credit shall be based on the ‘DPE’ wages required and the “invoice price” of the materials/equipment needed.

7.3.1 “DPE” shall be defined to mean “direct personnel expense”. Direct payroll expense includes prevailing wage rates plus a maximum multiplier of 1.35 times DPE. For example, if the prevailing wage rate is $50/hour, the DPE would be $67.50/hour (50 x 1.35).

7.3.2 “Invoice price” of materials/equipment shall be defined to mean the actual cost of materials and/or equipment that is paid by the Contractor, (or subcontractor), to a material distributor, direct factory vendor, store, material provider, or equipment leasing entity. Rates for equipment that is leased and/or owned by the Contractor or subcontractor(s) shall not exceed those listed in the latest version of the “Means Building Construction Cost Data” publication.

7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor’s own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a
mark-up not exceeding seven- and one-half percent (7.5%) on the subcontractors’ work. These mark-ups shall include all costs including, but not limited to overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractor’s subcontractor. No additional costs shall be allowed for changes related to the Contractor’s onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

ARTICLE 8: TIME

8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.

8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor’s control, the Contract Time shall be extended for such reasonable time as the Owner may determine.

8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility.

8.4 SUSPENSION AND DEBARMENT

8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, “Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule established by the Agency in the Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project.”

8.4.2 “Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the
Contractor and the Agency. Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record.”

8.5 RETAINAGE

8.5.1 Per Section 6962(d)(5) a.3, Title 29, Delaware Code: The Agency may at the beginning of each public works project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor’s failure to meet their responsibilities, the Agency may forfeit, at its discretion, all, or part of the Contractor’s retainage.

8.5.2 This forfeiture of retainage also applies to the timely completion of the punch list. A punch list will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punch list is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punch list be delayed beyond the established date due to the Contractor’s failure to meet their responsibilities, the Agency may hold permanently, at its discretion, all, or part of the Contractor’s retainage.

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

9.1.1 Applications for payment shall be made upon AIA Document G702. There will be a five percent (5%) retainage on all Contractor's monthly invoices until completion of the project. This retainage may become payable upon receipt of all required closeout documentation, provided all other requirements of the Contract Documents have been met.

9.1.2 A date will be fixed for the taking of the monthly account of work done. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified, if found necessary, and approved for the amount. Statement shall be submitted to the Owner.

9.1.3 Section 6516, Title 29 of the Delaware Code annualized interest is not to exceed 12% per annum beginning thirty (30) days after the “presentment” (as opposed to the date) of the invoice.

9.2 PARTIAL PAYMENTS

9.2.1 Any public works Contract executed by any Agency may provide for partial payments at the option of the Owner with respect to materials placed along or upon the sites or stored at secured locations, which are suitable for use in the performance of the contract.

9.2.2 When approved by the agency, partial payment may include the values of tested and acceptable materials of a nonperishable or noncontaminative nature which have been produced or furnished for incorporation as a permanent part of the work yet to be completed, provided acceptable provisions have been made for storage.

9.2.2.1 Any allowance made for materials on hand will not exceed the delivered cost of the materials as verified by invoices furnished by the Contractor, nor will it exceed the contract bid price for the material complete in place.
9.2.3 If requested by the Agency, receipted bills from all Contractors, Subcontractors, and material, men, etc., for the previous payment must accompany each application for payment. Following such a request, no payment will be made until these receipted bills have been received by the Owner.

9.3 SUBSTANTIAL COMPLETION

9.3.1 When the building has been made suitable for occupancy, but still requires small items of miscellaneous work, the Owner will determine the date when the project has been substantially completed.

9.3.2 If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment that it shall not constitute a waiver of claims.

9.3.3 On projects where commissioning is included, the commissioning work as defined in the specifications must be complete prior to the issuance of substantial completion.

9.4 FINAL PAYMENT

9.4.1 Final payment, including the five percent (5%) retainage if determined appropriate, shall be made within thirty (30) days after the Work is fully completed and the Contract fully performed and provided that the Contractor has submitted the following closeout documentation (in addition to any other documentation required elsewhere in the Contract Documents):

9.4.1.1 Evidence satisfactory to the Owner that all payrolls, material bills, and other indebtedness connected with the work have been paid,

9.4.1.2 An acceptable RELEASE OF LIENS,

9.4.1.3 Copies of all applicable warranties,

9.4.1.4 As-built drawings,

9.4.1.5 Operations and Maintenance Manuals,

9.4.1.6 Instruction Manuals,

9.4.1.7 Consent of Surety to final payment.

9.4.1.8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected, and all unsatisfactory conditions remedied.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY
10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to workers, persons nearby who may be affected, the Work, materials, and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws ordinances, rules regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.

10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.

10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.

10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified, or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.

11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.

11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to
demolition work and evidence of these coverages shall be filed with and approved by the Owner.

11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this project.

11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, may be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.

11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.

11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

<table>
<thead>
<tr>
<th>Coverage</th>
<th>Minimum Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodily Injury</td>
<td>$500,000</td>
</tr>
<tr>
<td></td>
<td>$1,000,000</td>
</tr>
<tr>
<td></td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Property Damage</td>
<td>$500,000</td>
</tr>
<tr>
<td></td>
<td>$1,000,000</td>
</tr>
</tbody>
</table>

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

<table>
<thead>
<tr>
<th>Coverage</th>
<th>Minimum Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodily Injury</td>
<td>$500,000</td>
</tr>
<tr>
<td></td>
<td>$1,000,000</td>
</tr>
<tr>
<td></td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Property Damage</td>
<td>$500,000</td>
</tr>
<tr>
<td></td>
<td>$500,000</td>
</tr>
</tbody>
</table>

11.7.3 Automobile Liability Insurance

Minimum coverage to be:
11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.

11.7.5 Workmen's Compensation (including Employer's Liability):

11.7.5.1 Minimum Limit on employer's liability to be as required by law.

11.7.5.2 Minimum Limit for all employees working at one site.

11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.

11.7.7 Social Security Liability

11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor’s business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.

11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.

11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

**ARTICLE 12: UNCOVERING AND CORRECTION OF WORK**

12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of two years from the date of Substantial Completion, or by terms of an applicable special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.

12.2 At any time during the progress of the work, or in any case where the nature of the defects shall be such that it is not expedient to have them corrected, the Owner, at their option, shall have the right to deduct such sum, or sums, of money from the amount of the contract as
they consider justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 CUTTING AND PATCHING

13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

13.2 DIMENSIONS

13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the project site. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.

13.3 LABORATORY TESTS

13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.

13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.

13.4 ARCHAEOLOGICAL EVIDENCE

13.4.1 Whenever, in the course of construction, any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the authorities of the State Historic Preservation Office and suspend work in the immediate area for a reasonable time to permit those authorities, or persons designated by them, to examine the area and ensure the proper removal of the archaeological evidence for suitable preservation by the Division of Historical and Cultural Affairs.
13.5 GLASS REPLACEMENT AND CLEANING

13.5.1 The General Contractor shall replace without expense to the Owner all glass broken during the construction of the project. If job conditions warrant, at completion of the job the General Contractor shall have all glass cleaned and polished.

13.6 WARRANTY

13.6.1 For a period of two (2) years from the date of substantial completion, as evidenced by the date of final acceptance of the work, the contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect of equipment, material or workmanship performed by the contractor or any of his subcontractors or suppliers. However, manufacturer's warranties and guarantees, if for a period longer than two (2) years, shall take precedence over the above warranties. The contractor shall remedy, at his own expense, any such failure to conform or any such defect. The protection of this warranty shall be included in the Contractor’s Performance Bond.

ARTICLE 14: TERMINATION OF CONTRACT

14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner’s option, and the Owner may terminate the Contract and take possession of the site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.

14.2 “If the continuation of this Agreement is contingent upon the appropriation of adequate state, or federal funds, this Agreement may be terminated on the date beginning on the first fiscal year for which funds are not appropriated or at the exhaustion of the appropriation. The Owner may terminate this Agreement by providing written notice to the parties of such non-appropriation. All payment obligations of the Owner will cease upon the date of termination. Notwithstanding the foregoing, the Owner agrees that it will use its best efforts to obtain approval of necessary funds to continue the Agreement by taking appropriate action to request adequate funds to continue the Agreement.”

END OF GENERAL REQUIREMENTS
EMPLOYEE DRUG TESTING REPORT FORM
Period Ending: ____________________

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds maintain testing data that includes but is not limited to the data elements below.

Project Number: WBZ-9
Project Name: Quarantine Support Building at Brandywine Zoo
Contractor/Subcontractor Name: ________________________________
Contractor/Subcontractor Address: ________________________________

Number of employees who worked on the jobsite during the report period: ____________
Number of employees subject to random testing during the report period: ____________
Number of Negative Results ________ Number of Positive Results ________
Action taken on employee(s) in response to a failed or positive random test:
________________________________________________________________________
________________________________________________________________________

Date: ______________

This form is not required to be submitted to the Owner. Included as a reference to show information required to be maintained by the Contractor. The Owner shall have the right to periodically audit all Contractor and Subcontractor test results at the Contractor’s or Subcontractor’s offices (or by other means to make the data available for inspection by the Owner).
EMPLOYEE DRUG TESTING
REPORT OF POSITIVE RESULTS

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds to notify the Owner in writing of a positive random drug test.

Project Number: WBZ-9
Project Name: Quarantine Support Building at Brandywine Zoo
Contractor/Subcontractor Name: ____________________________________________
Contractor/Subcontractor Address: __________________________________________
Name of employee with positive test result: _________________________________
Last 4 digits of employee SSN: ______________________________
Date test results received: ______________________________
Action taken on employee in response to a positive test result:
________________________________________________________________________
________________________________________________________________________
Authorized Representative of Contractor/Subcontractor: _________________________
(typed or printed)
Authorized Representative of Contractor/Subcontractor: _________________________
/signature

Date: __________________

This form shall be sent by mail to the Owner within 24 hours of receipt of test results.

Enclose this test results form in a sealed envelope with the notation "Drug Testing Form – DO NOT OPEN" on the face thereof and place in a separate mailing envelope.
SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Work under separate contract.
   4. Unit Prices.
   5. Applications for Payment.
   6. Owner Supplied Construction Documents.
   7. Coordination.
   8. Phased construction.
   10. Work restrictions.
   12. Field Engineering.
   13. References and Standards.

B. Related Requirements:
   1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: Quarantine Support Building
   1. Project Location: 1001 N. Park Drive Wilmington, DE 19802

B. Owner: City of Wilmington, Division of Natural Resources and Environmental Control, Parks and Recreation, 89 Kings Highway, Dover DE 19901.

C. Project Manager: State of Delaware, Division of Natural Resources and Environmental Control, Parks and Recreation, 89 Kings Highway, Dover, DE 19901.
D. Architect/Engineer’s Identification: The Contract Documents, dated April 20, 2020, were prepared for this Project by GWWO, Inc.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Project involves a new two story 4,134 square foot building for the Brandywine Zoo. The building will serve as service building for the zoo staff with a lab, exam room, holding areas, restrooms, showers, and mechanical space.

B. Type of Contract:

1. Project will be constructed under a single, lump sum, 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 as it will have an impact on the General Contractor's scope of work. The General Contractor shall allow the separate contractors access to scaffolding and/or high reaches.

1. Items noted “NIC” (Not in Contract) will be furnished and installed by others.

1.6 UNIT PRICES

A. Unit Prices quoted on the Bid form will be exercised as Owner option.

B. Coordinate related work and modify surrounding work affected by accepted unit prices as required to complete the Work.

C. Schedule of Unit Prices: Refer to Section 012200 Unit Prices.

1.7 APPLICATIONS FOR PAYMENT

A. Submit three (3) originals of each application under procedures of Section 012900 Payment Procedures.

B. Content and Format: Use the Project Manual table of contents to develop the Schedule of Values.
1.8 OWNER SUPPLIED CONSTRUCTION DOCUMENTS

A. The Contractor will be furnished, free of charge, five (5) copies of the drawings and Project Manuals (or less if requested). Additional sets will be furnished at the cost of reproduction, postage, and handling.

1.9 COORDINATION

A. Coordinate Work of the various sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items installed later.

B. Verify characteristics of elements of interrelated operating equipment are compatible; coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. Coordinate space requirements and installation of mechanical, electrical, and plumbing work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduits, as closely as practicable; make runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas (except as otherwise shown), conceal pipes, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.

E. Execute cutting and patching to integrate elements of Work, uncover ill-timed defective and non-conforming work, provide openings for penetrations of existing surfaces, and provide samples for testing. Seal penetrations through floors, walls, and ceilings.

1.10 PHASED CONSTRUCTION

A. The Work shall be conducted in one phase.

1.11 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

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

1. Limits: Confine construction operations to the areas as indicated. The surrounding buildings/site are occupied, and the Owner’s operations shall not be disturbed.

2. Driveways, Walkways and Entrances: Keep public roads, public parking, driveways, and entrances outside of the work area serving premises clear and available to Owner,
Owner's employees, emergency vehicles and general public at all times. Do not use these areas for parking or 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.

3. The adjacent building areas, site and properties are occupied and shall not be disturbed.

1.12 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.
2. Refer to Section 011400 “Work Restrictions” for additional requirements.

B. On-Site Work Hours: Limit work to the site and/or existing building to normal business working hours of 7:00 a.m. to 5:00 p.m. Monday through Friday, unless otherwise indicated.

1. Weekend Hours: Weekend work shall not be allowed unless preapproved by the Owner.
2. Early Morning Hours: Early morning hours are not allowed unless required for utility shutdowns.

C. Noise, Vibration, and Odors: Coordinate operations that may result in any level of noise and vibration, odors, or other disruption to the occupancy or use of adjacent occupied areas, the buildings, and adjacent properties with the Owner.

1. Notify Architect and Owner not less than seven (7) days in advance of proposed disruptive operations.
2. Obtain Architect's and/or Owner's written permission before proceeding with disruptive operations.

D. Nonsmoking Campus and Building: Smoking is prohibited within the boundaries of all state workplaces including all buildings, facilities, indoor and outdoor spaces and all the surrounding grounds owned by the State. This policy also includes but is not limited to parking lots, walkways, State vehicles and private vehicles parked or operated on State workplace property.

1.13 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.

1.14 FIELD ENGINEERING

A. Provide field engineering services; establish grades, lines, and levels, by use of recognized engineering survey practices.

B. Control datum for survey is that shown on drawings. Locate and protect control and reference points.

1.15 REFERENCES AND STANDARDS

A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. The date of the standard is that in effect as of the Bid date, except when a specific date is specified.

C. Obtain copies of standards when required by Contract Documents. Maintain copy at job site during progress of the specific work.

1.16 MISCELLANEOUS PROVISIONS

A. SCHEDULE

1. The following is the required schedule for this work:
a. **Bids Due:** July 9, 2020 at 9:00 AM  

b. **Notice of Building Contract Award:** Within thirty (30) days of receipt and acceptance of qualified low bid.  
c. **Purchase Order Issuance:** The issuance of a State of Delaware purchase order is contingent upon the successful Contractor submitting bonds on State-approved forms, signed contracts and insurance certificates to the State of Delaware within 20 days of Notice of Award. A purchase order will be issued in approximately thirty days after these items have been submitted to the State of Delaware.  
d. **On-Site Mobilization:** Upon receipt of State of Delaware purchase order.  
e. **Substantial Completion:** The work shall be completed shall be completed eight (8) months from on-site start of work.  
f. **Completion of Punch List:** 21 days from date of substantial completion.

1) Refer to the General Requirements for additional details.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00
SECTION 01 14 00 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to the limits indicated on the drawings. Do not disturb areas to remain occupied during the renovations.
2. Owner Occupancy: The surrounding occupied areas, site, buildings, roadways, access into the buildings, etc. beyond the work area shall remain accessible to the Owner.
3. Parking: Parking is available within the Park at the Education Center or on Van Buren Street.
4. Dumpster: The dumpster shall be covered to avoid windblown debris. Debris shall be removed on a regular basis in order to avoid an overflowing dumpster. Restoration of grounds disturbed by the dumpster will be required upon completion of the Project. “No Trespassing” signs shall be placed on the dumpster. The dumpster can be located within the work area. The dumpster will be subject to other people using it or removing material from it. It is preferred that rubbish, demolished materials, etc. be removed from on a daily basis.
5. Access: Access is available 7:30 AM to 4:30 PM. Later time are available upon notice. The Zoo will NOT be closed to the public while this work is taking place. The primary access for equipment with through the gate at the work area.
6. Storage: Storage will be allowed onto the confines of the site.
7. The site is to be secured so that access is prohibited during demolition. The site manager and the Fire Department are to have access to this during construction, after hours, and during weekends when the zoo is open to the public.
8. Public Roadways, Driveways, Entrances and Public Sidewalks: Keep public roadways, driveways, entrances, and public sidewalks serving premises clear and available to the Public, Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
   a. Schedule deliveries to minimize use of roadways, driveways, sidewalks, and entrances.
   b. The Owner will not sign for any deliveries at any time.
   c. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
9. Contractor and subcontractor promotional signage will not be allowed at the project site or within the Park unless approved by the Owner.
B. Use of Existing Building: Maintain the existing building in a weathertight condition throughout renovation period. Repair damage caused by construction operations. Protect building and its contents during construction period.

1. The Contractor shall be provided full access to Quarantine Support Building as necessary to complete the work.
2. Use of the Owner’s telephones will not be allowed.
3. Flammable materials shall not be stored in the Quarantine Support Building. Flammable materials shall be kept outside, away from all buildings, in a flammable liquid/material storage box.
4. Gas powered equipment will not be allowed in the buildings or near windows and intake louvers at any time.
5. Debris shall be removed from and around the Quarantine Support Building including the sidewalks, trails, and parking areas on a daily basis.
6. At no times shall equipment be left operating in and around Quarantine Support Building after hours or when no one is present in the building.
7. Noisy activities shall take place during the hours defined by the City of Wilmington and prescheduled with the Owner to avoid disruption of their activities.
8. Access to water and electric will be provided.
9. There will be no restroom facilities available during Quarantine Support Building. The Contractor shall provide a self contained toilet unit securely attached to the ground and kept locked after hours.
10. Dogs or other animals shall not be brought onto the property at any time.
11. Children shall not be brought onto the site at any time.
12. The general surrounds of Quarantine Support Building are open to the public and those working at the site shall not use abusive language.
13. Radios or other music-playing devices will not be allowed. Headphones and ear buds will not be allowed.
14. Fire extinguishers shall always be kept in the areas under renovation at Quarantine Support Building.
15. All work taking place on the site shall be monitored by the contractor’s project superintendent at all times even if the General Contractor’s work forces are not working at the site.
16. The Project superintendent shall discuss weekly with the DNREC Project Manager to review the activities planned for that week to avoid miscommunication, facilitate the renovation process and to maintain the Owner’s operations.
17. Walk off mats shall be provided at entrances to all construction areas from public ways.
18. Provide protective barriers and covers at entrances and public access areas where work is taking place overhead.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 14 00
SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes administrative and procedural requirements governing allowances.
B. Selected materials and equipment are specified in the Contract Documents by Allowances. In some cases, these Allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Proposal Request.
C. Types of allowances include the following:
   1. Lump-sum allowances.
   2. Unit-cost Allowances.
   3. Contingency Allowances.
D. Related Requirements:
   1. Section 012200 "Unit Prices" for procedures for using unit prices.

1.3 SELECTION AND PURCHASE
A. At the earliest practical date after award of the Contract, advise Owner of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
B. At Owner's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
C. Purchase products and systems selected in writing by Owner from the designated supplier.

1.4 ACTION SUBMITTALS
A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
1.5 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain, and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.

2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.

3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.

2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

1.9 Contingency Allowances:

A. Use the Contingency Allowance only as directed for the Owner's purposes and only by Change Orders that indicate amounts to be charged to the Allowance.

B. Change Orders authorizing use of funds from the Contingency Allowance, for purchase of products and equipment, will include Contractor's related costs and reasonable overhead and profit margins. These related costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

C. At Project Closeout, credit unused amounts remaining in the Contingency Allowance to the Owner by Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

END OF SECTION 01 21 00
SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes administrative and procedural requirements for unit prices.
B. Related Sections include the following:
   1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS
A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES
A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
D. List of Unit Prices: A list of unit prices is included at the end of this Section. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

A. Unit Price No. 1 – Concrete Paving
   1. Description: Provide cost per square yard to install Concrete Paving per Slab Type S1A on sheet S101.
   2. Note: Base Bid includes all Concrete Paving indicated on the Civil, Structural, and Landscape Drawings.
   3. Unit of Measurement: Unit SQ YD

B. Unit Price No. 2- Asphalt Paving
   1. Provide cost per square yard to install Asphalt Paving per Heavy Paving Section for Entrances and Drives on sheet C-110.
   2. Note: Base Bid includes all paving indicated on the Civil and Landscape Drawings.
   3. Unit of Measurement: Unit SQ YD

C. Unit Price No. 3- Unsatisfactory Soil
   1. Removal of one cubic yard of unsatisfactory soil under floor slabs and foundations beyond what is indicated in the construction documents and replacement with satisfactory structural fill material per cubic yard according to Section 31 20 00.
   2. Unit of Measurement: Unit CU YD

D. Unit Price No. 4 – Unsatisfactory Soil at Walkways
   1. Removal of one cubic yard of unsatisfactory soil under walkways beyond what is indicated in the construction documents and replacement with satisfactory fill under walkways according to Section 31 20 00.
   2. Unit of Measurement: Unit CU YD

E. Unit Price No. 5 – Landscape Boulders
   1. Provide cost per ton to procure and install Landscape Boulders.
   2. Note: Base Bid includes boulders indicated on the Civil and Landscape Drawings.
   3. Unit of Measurement: Unit TON

F. Unit Price No. 6 – Excavation of Rock/Boulders
   1. Provide cost per cubic yard for excavation for rock/boulders one cubic yard and larger in volume, including all necessary equipment and relocation of rock/boulders.
   2. Unit of Measurement: Unit CU YD.

END OF SECTION 01 22 00
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate 1: Caging Material

1. In lieu of galvanized caging change to stainless steel caging in medium and large animal rooms numbers: 101A, 101B, 101C, 103A, 103B, 110, and 111.
2. Base Bid includes galvanized caging material in the rooms listed above.

END OF SECTION 01 23 00
SECTION 01 24 00 - PERMITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes permits that have been issued for this Project as well as permits-in-progress initiated by the Owner and those required Contractor application.

1.3 DEFINITIONS

A. Permits: A document issued by the Authorities having jurisdiction approving specific construction. Permits may approve the documents as submitted or contain caveats that are to be followed.

1. Preconstruction Permits: Permits issued prior to the bidding and award and which are required prior to proceeding to this stage.

2. Post Bid Permits: Permits required to by applied for by the successful contractor. These include demolition permits, building permits and sub-permits such as mechanical, electrical, fire suppression and plumbing.

3. Post Construction Permits: Permits issued by the authorities having jurisdiction stating that a structure or portion of the structure has been approved as complying with applicable laws, regulations and codes and may be occupied and put to its intended use.

1.4 RESPONSIBILITIES

A. The Contractor shall abide by the approved permits which are to include the notations provided by the entity/person approving the permit.

B. The Contractor is responsible for obtaining and paying for all construction permits unless stated otherwise in the construction documents.

1. The Contractor shall conform to all of the regulations and requirements, and shall be responsible for costs associated therewith, of all permits required of the Work.

2. The Contractor shall be responsible for scheduling all inspections as required by the permits.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 SCHEDULE OF ISSUED PERMITS
   A. None Issued.

3.2 SCHEDULE OF PENDING PERMITS.
   A. City of Wilmington Civil Permit

END OF SECTION 01 24 00
SECTION 01 25 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 1 Section “Submittal Procedures for” administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

   c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

1.5 CHANGE ORDER PROCEDURES


1.6 CONSTRUCTION CHANGE DIRECTIVE


1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

END OF SECTION 01 25 00
SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

   a. Application for Payment forms with Continuation Sheets.

2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

   a. Project name and location.
   b. Name of Architect.
   c. Architect's project number.
d. Contractor's name and address.

e. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

a. Related Specification Section or Division.
b. Description of the Work.
c. Change Orders (numbers) that affect value.
d. Dollar value.

1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed:

a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. List of Contractor's staff assignments (Project Superintendent specifically).
5. Copies of building permits.
6. Certificates of insurance and insurance policies.
7. Performance and payment bonds.

G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Updated final statement, accounting for final changes to the Contract Sum.
2. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
4. AIA Document G707, "Consent of Surety to Final Payment."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00
(THIS PAGE INTENTIONALLY LEFT BLANK)
SECTION 01 31 00 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Administrative and supervisory personnel.
3. Project meetings.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
2. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in various 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 with subcontractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. If necessary, 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 if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.

1.4 SUBMITTALS

A. Staff Names: Within 15 days of notice to proceed, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1.5 PROJECT MEETINGS

A. General: The Architect will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participant, and others involved, and individuals whose presence is required, of date and time of each meeting.
2. Minutes: The Architect will record significant discussions and agreements achieved. The minutes will be distributed to everyone concerned, including Owner, within 7 days of the meeting.

B. Preconstruction Conference: A preconstruction conference will be scheduled before the start of construction, at a time convenient to the Owner and Contractor, but no later than 15 days after execution of the Agreement. The conference will be held at the Project. The meeting will be conducted to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Items of significance that could affect progress will be discussed, including the following:
   a. Tentative construction schedule.
   b. Designation of responsible personnel.
   c. Procedures for processing field decisions and Change Orders.
   d. Procedures for processing Applications for Payment.
   e. Submittal procedures.
   f. Preparation of Record Documents.
   g. Use of the premises.
   h. Responsibility for temporary facilities and controls.
   i. Parking availability.
   j. Storage areas.
   k. Equipment deliveries and priorities.
l. Progress cleaning.
m. Working hours.

C. Progress Meetings: Progress meetings will be conducted every two weeks. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. 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.

   b. Review present and future needs of each entity present, including the following:

      1) Deliveries.
      2) Off-site fabrication.
      3) Access.
      4) Site utilization.
      5) Temporary facilities and controls.
      6) Work hours.
      7) Progress cleaning.
      8) Quality and work standards.

3. Reporting: The Architect will distribute minutes of the meeting to each party present and to parties who should have been present. A brief summary, in narrative form, of progress since the previous meeting and report will be included.

   a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. The revised schedule will be issued concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00
SECTION 01 31 50 – FIELD ENGINEERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions and procedural requirements for Field Engineering services, including, but not necessarily limited to the following:

1. Land Survey Work.
2. Engineering services.

1.3 SUBMITTALS

A. Certificates: Submit a certificate signed by the Land Surveyor certifying that the location and elevation of improvements comply with the Contract Documents.

B. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of Sections "Submittals" and "Project Closeout".

1.4 QUALITY ASSURANCE

A. Surveyor: Engage a Professional Land Surveyor, licensed in the State of Delaware, to perform required surveying services to ensure that grades, lines, levels, and locations of the Work are in compliance with the Contract Documents.

B. Engineer: Engage a Professional Engineer of the discipline required, registered in the State of Delaware, to perform required engineering services.

1.5 EXAMINATION

A. The Owner will identify existing control points and property line corner stakes.

B. Verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.

1. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.

2. Promptly replace lost or destroyed Project control points. Base replacements on the original survey control points.
C. Establish and maintain a minimum of two permanent benchmarks on the site, referenced to data established by survey control points.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

D. Existing utilities and equipment: 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 and other construction.

1.6 PERFORMANCE

A. Working from lines and levels established by the property survey, establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.

1. Advise entities engaged in construction activities, of marked lines and levels provided for their use.
2. As construction proceeds, check every major element for line, level and plumb.

B. Surveyor's Log: Maintain a surveyor's log of control and other survey Work. Make this log available for reference.

1. Record deviations from required lines and levels and advise the Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.
2. On completion of foundation walls, major site improvements, and other Work requiring field engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.

D. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels and control lines and levels required for mechanical and electrical work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 50
SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Field condition reports.
3. Special reports.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Major Area: A story of construction, a separate building, or a similar significant construction element.

F. Milestone: A key or critical point in time for reference or measurement.
1.4 SUBMITTALS

A. Preliminary Construction Schedule: Submit two opaque copies.
B. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
C. Field Condition Reports: Submit two copies at time of discovery of differing conditions.
D. Special Reports: Submit two copies at time of unusual event.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
C. Activities: Treat each separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
3. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Use of premises restrictions.
   d. Seasonal variations.
   e. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Mockups.
   b. Fabrication.
   c. Deliveries.
   d. Installation.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragments to demonstrate the effect of the proposed change on the overall project schedule.

2.2 CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit horizontal bar-chart-type construction schedule within five days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site.
   2. List of separate contractors at Project site.
   3. Approximate count of personnel at Project site.
   4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Emergency procedures.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Construction Change Directives received and implemented.
15. Substantial Completions authorized.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare, and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At bi-weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, and other parties identified by Contractor with a need-to-know schedule responsibility.

END OF SECTION 01 32 00
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. This Section includes administrative and procedural requirements for the following:

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

B. Related Sections include the following:

1. Division 01 Section "Submittal Procedures" for submitting photographic documentation.
2. Division 01 Section "Closeout Procedures" for submitting digital media as Project Record Documents at Project closeout.
3. Division 01 Section "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.3 SUBMITTALS

A. Construction Digital Images: Submit a complete set of digital image electronic files as part of the Project closeout on CD-ROM, DVD, or flash drive. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in uncompressed TIFF or JPEG format, produced by a digital camera with minimum sensor size of 12.0 megapixels, and at an image resolution of not less than 4000 by 3000 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Photographs are to be taken weekly at a minimum during normal construction and daily during small duration projects or significant activities.
2. Photographs are to be taken prior to the start of the work to record existing conditions.
3. Photographs are to be taken when areas are opened prior to the start of the new work.
4. Photographs are to be taken during demolition operations.
5. Provide temporary lighting when required to produce clear, well-lit photographs without obscuring shadows.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
   1. Date and Time: Include date and time in filename for each image.
   2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.

C. Preconstruction Photographs: Before commencement of excavation and/or demolition, and starting of construction take color, digital photographs of Project building interior and exterior, site and surrounding properties, including existing items to remain during construction, from different vantage points, or as directed by Architect.
   1. Flag excavation areas and construction limits before taking construction photographs.
   2. Take a minimum of eight photographs to show existing conditions adjacent to building before starting the Work.
   3. Take a minimum of eight photographs of existing buildings adjacent to the building to accurately record physical conditions at start of construction.
   4. Take a minimum of four photographs of each existing room even if renovations are not planned in that space.
   5. Take as many photographs as necessary to document the exterior of the existing building.
   6. Take additional photographs as required to record settlement or cracking of adjacent pavements, and other improvements.

D. Architect-Directed Construction Photographs: From time to time, Architect will instruct the Contractor about number and frequency of color, digital photographs, and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take a minimum of four-color photographs of each room and eight color photographs of the exterior after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points.
   1. Do not include date stamp.
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
4. Division 1 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
5. Division 1 Section "Closeout Procedures" for submitting warranties.
6. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
7. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals. The Contractor will be responsible for field verifying existing conditions.

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. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow enough 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.

D. Identification: Place a permanent label or title block on each submittal for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
   3. Include the following information on label for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Name and address of Architect.
      d. Name and address of Contractor.
      e. Name and address of subcontractor.
      f. Name and address of supplier.
      g. Name of manufacturer.
      h. Submittal number or other unique identifier, including revision identifier.
         1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
      i. Number and title of appropriate Specification Section.
      j. Drawing number and detail references, as appropriate.
      k. Location(s) where product is to be installed, as appropriate.
      l. Other necessary identification.
E. Deviations: Highlight or otherwise specifically identify deviations from the Contract Documents on submittals.

F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
2. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.

G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.

1. Transmittal Form: Provide locations on form for the following information:
   a. Project name.
   b. Date.
   c. Destination (To:).
   d. Source (From:).
   e. Names of subcontractor, manufacturer, and supplier.
   f. Category and type of submittal.
   g. Submittal purpose and description.
   h. Specification Section number and title.
   i. Drawing number and detail references, as appropriate.
   j. Submittal and transmittal distribution record.
   k. Remarks.
   l. Signature of transmitter.

2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Furnish as Submitted".

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
J. Use for Construction: Use only final submittals with mark indicating "Furnish as Submitted" or "Revise as Noted & Furnish" taken by Architect.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. CADD files are limited to those that have been generated for this Project.
2. CADD files for the floor plans and roof plans shall be provided. Files for details, etc. will not be provided.
3. Contractor will be asked to sign Architects waiver of release form before files will be delivered to the contractor.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's written recommendations.
   b. Manufacturer's product specifications.
   c. Manufacturer's installation instructions.
   d. Standard color charts.
   e. Manufacturer's catalog cuts.
   f. Wiring diagrams showing factory-installed wiring.
   g. Printed performance curves.
   h. Operational range diagrams.
   i. Mill reports.
   j. Standard product operation and maintenance manuals.
   k. Compliance with specified referenced standards.
   l. Testing by recognized testing agency.
   m. Application of testing agency labels and seals.
   n. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Submit six (6) copies of Product Data, unless otherwise indicated. Architect will return three copies. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Dimensions.
   b. Identification of products.
   c. Fabrication and installation drawings.
   d. Roughing-in and setting diagrams.
   e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
   f. Shopwork manufacturing instructions.
   g. Templates and patterns.
   h. Schedules.
   i. Design calculations.
   j. Compliance with specified standards.
   k. Notation of coordination requirements.
   l. Notation of dimensions established by field measurement.
   m. Relationship to adjoining construction clearly indicated.
   n. Seal and signature of professional engineer if specified.
   o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).

3. Number of Copies: Submit six (6) opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Submit five copies where copies are required for operation and maintenance manuals. Architect will retain three copies; remainder will be returned.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of appropriate Specification Section.
3. **Disposition:** Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   
a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. **Samples for Initial Selection:** Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   
a. **Number of Samples:** Submit 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.

5. **Samples for Verification:** Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   
a. **Number of Samples:** Submit four sets of Samples. Architect will retain three Sample sets; remainder will be returned.
   
   1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
   
   2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least four sets of paired units that show approximate limits of variations.

E. **Product Schedule or List:** 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.
2. **Number and name of room or space.**
3. **Location within room or space.**
4. **Number of Copies:** Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
   
a. **Mark up and retain one returned copy as a Project Record Document.**
F. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation" for Construction Manager's action.

G. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

H. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."

I. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."

J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entities performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
   a. Mark up and return one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
   1. Number of Copies: Submit three copies of each submittal, unless otherwise indicated. Architect will not return copies.
   2. Certificates and Certifications: Provide a notarized 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.
   3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names, and addresses of architects and owners, and other information specified.
E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare 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.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare 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.

K. Product Test Reports: Prepare written reports indicating 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.

L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

M. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."

N. Preconstruction Test Reports: Prepare 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.

O. Compatibility Test Reports: Prepare 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.

P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.

Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."

R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturers. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service 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.

U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
   
   1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

PART 3 - EXECUTION

3.1 CONTRACTOR’S REVIEW

A. 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. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor’s approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT’S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

   1. Furnish as Submitted.
   2. Revise as Noted & Furnish.
   3. Revise as Noted & Furnish. Submit Revised Copy for Record.
   4. Revise & Resubmit.

C. 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.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00
Date:

To: (here within referred to as the licensee)

From: GWWO, Inc.
800 Wyman Park Dr. Suite 300, Baltimore, Maryland 21211

Project: Brandywine Zoo Quarantine Support Building

Project No.: 19040

Re: Limited Nonexclusive License for use of Architect’s Electronic Format Instruments of Service

Electronic Media Contents: CAD Files

GWWO, Inc. grants the above licensee a nonexclusive license to reproduce the Architect’s Instruments of Service identified above solely for the purpose of submittal backgrounds for the Project identified above, conditioned upon GWWO’s receipt of:

- a signed copy of this agreement letter

The licensee shall not assign, delegate, sublicense, pledge, or otherwise transfer the license granted herein to another party. Further, the licensee acknowledges that the Architect’s Instruments of Service are representational of the design intent for the Project and are not represented or warranted to be accurate. Additionally, use of the Architect’s Instruments of Service is not a defense for failure to conform with the requirements of the Contract Documents. Use under the terms of this agreement does not entitle the licensee to any changes from or substitutions to the requirements of the Contract Documents. Reliance on dimensional or other information contained or inherent in electronic drawing data is at the licensee’s sole risk. No transfer of rights or electronic data to a third party shall be permitted. GWWO, Inc. does not warrant the fitness of said electronic media or its contents for any specific purpose.

We agree with the conditions set forth above, and I have the authority to represent my company:

______________________________  ______________________________
Signature                      Date

______________________________  ______________________________
Printed Name of Licensee       Licensee Company

______________________________
Title of Licensee
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

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

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

C. Related Sections include but are not limited to the following:

1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.

2. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and
completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

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

J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.

K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the
most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Qualification Data: 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.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspection.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee
QUALITY REQUIREMENTS

payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. 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.

D. 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.

E. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

F. 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.

   1. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

G. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and reinspection 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. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. 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.
   1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

D. Retesting/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, for construction that replaced Work that failed to comply with the Contract Documents.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

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

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.

1. Distribution: Distribute schedule to Owner, Architect testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, 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 and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspection corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. 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 modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."
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 SECTION 01 40 00
SECTION 01 42 00 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic contract definitions are included in the Conditions of the Contract.

B. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference. Location is not limited.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.

D. "Approved": The term "approved," when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": The term "install" describes operations at the Project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is the Contractor, or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project;
being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.

2. **Trades:** Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

3. **Assigning Specialists:** Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.

   a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.

J. "Project site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 **SPECIFICATION FORMAT AND CONTENT EXPLANATION**

A. **Specification Format:** These Specifications are organized into Divisions and Sections based on the CSI/CSC's "MasterFormat" numbering system.

B. **Specification Content:** These 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. **Abbreviated Language:** Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.

   2. **Imperative mood and streamlined language** are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Section Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.

      a. 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.
1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents.

C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source and make them available on request.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.

1.5 SUBMITTALS

A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
PRODUCTS (Not Applicable)

PART 2 - EXECUTION (Not Applicable)

END OF SECTION 01 42 00
SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to testing agencies and authorities having jurisdiction.

B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

D. Telephone Service: Provide cell phone service for site Superintendent’s use and as required to contact Contractor site representatives.

E. Field Office: A prefabricated or mobile unit should be provided that includes space for Owner’s Representative and a conference room for progress meetings.

F. Fence: Fence separation must meet USDA requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air filtration system discharge.
5. Other dust-control measures.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Comply with Federal, State, and local codes and regulations as well as utility company requirements.

C. Coordinate work with Owner’s requirements.

D. Materials: Materials must be new and adequate in capacity for the required usage. Materials must not create unsafe conditions nor violate requirements of applicable codes and standards.

E. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
B. Maintain excavations free of water. Provide and operate pumping equipment. Grade site to drain water away from buildings and excavations.

C. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage.

D. Prohibit traffic and storage on waterproofed and roofed surfaces, on lawns and landscaped areas.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.

B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete bases for supporting posts.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

D. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 mm).

E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

F. Lumber and Plywood: Pressure-treated dimension lumber and plywood suitable for exterior exposure.

G. Paint: Exterior latex primer and matching topcoat.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect/Engineer, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
3. Drinking water and private toilet.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
6. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, U. rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Heating Equipment: Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

Provide potable water for drinking and construction purposes.

1. The Contractor shall make all necessary arrangements for temporary water service for construction purposes and furnish at his own expense all piping and accessories required.
2. Take positive measures to preclude cross-connections and backflow.
3. The Contractor will assume the cost of water consumed if responsible care and restraint are not exercised by the Contractor in its use.

B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

C. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

D. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
   1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
      a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
      b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
   2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
   3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
   1. Install electric power service underground unless otherwise indicated.
   2. Connect temporary service to Owner's existing power source, as directed by Owner.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Install lighting for Project identification sign.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect/Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Security: Security of persons and property in the areas under control of the Contractor shall be the Contractor’s exclusive responsibility.
   1. The Contractor, at his own expense, shall initiate whatever programs that are necessary to execute his responsibility.
   2. Control of access to the area under the Contractor’s control shall be maintained. Visitors shall be required to report immediately to the Contractor’s Superintendent and to produce full identification which will be recorded in the Contractor’s Daily Log along with the purpose of the visit.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants and control valves.
   3. Provide and maintain uninterrupted vehicular access to site and within to temporary construction facilities and work areas for persons and equipment involved in the construction Project.
   4. Maintain traffic areas free of excavated materials, construction equipment, products, snow, ice, and debris.

D. Traffic Regulation: Obtain all necessary permits for access to and use of public roads and streets for construction and hauling purposes. Comply with traffic control regulations applying to permit issuance.
   1. Provide markers, signs, lights, and barriers on and near the site to safely control construction traffic and public access.

E. Parking: Use designated areas of Owner's existing parking areas for construction personnel’s private vehicles and of Contractor’s light-weight vehicles.

F. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

G. Cleaning During Construction: Control accumulation of waste materials and rubbish. Periodically dispose of legally off site.
   1. Clean interior areas prior to the start of finish work. Maintain areas free of dust and other contaminants during finishing operations.
H. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

I. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

J. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

K. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
   1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
   2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
   3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
   4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

L. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

M. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

N. Site Enclosure Fence: Before construction operations begin, furnish, and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
   1. Extent of Fence: As required to enclose portion of site determined sufficient to accommodate construction operations and maintain security.
   2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish 10 sets of keys to Owner.

O. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

P. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

Q. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
R. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

S. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.4 MOISTURE AND MOLD CONTROL


B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

   a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
   b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
   c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 01 50 00
SECTION 01 56 00 - ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 ENVIRONMENTAL PROTECTION

A. Environmental protection considerations consist of, but are not limited to, the following factors:

1. Natural resources including air, water, and land.
2. Solid waste disposal.
4. Control of toxic substances and hazardous materials.
5. The presence of chemical, physical, and biological elements and agents that adversely effect and alter ecological balances.

1.2 GENERAL REQUIREMENTS

A. Provide and maintain environmental protection defined herein, other Sections and as indicated in the Drawings.

B. Comply with all Federal, State, and local laws, ordinances and regulations pertaining to environmental protection.

C. Compliance by subcontractors with the provisions of this and various other sections of these specifications is the responsibility of the Contractor.

D. Use of equipment from which factory-installed, anti-pollution and noise control devices are removed or rendered ineffective, either intentionally or through lack of proper maintenance is prohibited.

E. Furnish a certificate that all materials and operating equipment installed as a part of this project, the installation thereof and all equipment used in the construction, are in compliance with all applicable local laws, ordinances, regulations and permits concerning environmental pollution control and abatement.

1.3 PROTECTION OF NATURAL RESOURCES

A. General: It is intended that the natural resources within the project boundaries and outside the limits of permanent work performed be preserved in their existing condition, be restored to an equivalent of the existing condition or improved as indicated, as approved by the Architect/Engineer, upon completion of the work. Confine on-site construction activities to areas defined by the drawings and specifications.
1.4 TOXIC SUBSTANCES

B. Asbestos and Hazardous Materials Procedure: In the event the Contractor, during the course of the work on the project, encounters the presence of asbestos or any materials containing asbestos, or polychlorinated biphenyl (PCB's) or any other hazardous materials as recognized by local Authorities having jurisdiction, promptly notify the Owner through the Architect/Engineer. Do not perform any work pertinent to the asbestos or hazardous material prior to receipt of special instructions from the Owner through the Architect/Engineer. Any delay in the progress of the work as a result of encountering either asbestos or hazardous materials on the project will be mitigated by the Architect/Engineer. Within 24 hours of this notification to the Owner through the Architect/Engineer of the encountering of the presence of asbestos or hazardous materials, the Contractor will meet with the Architect/Engineer to replan and work around the affected area. The Architect/Engineer will provide the special instructions without delay and upon confirmation by the local Authorities of the actions taken and authorize work to progress.

C. Comply with all applicable provisions of the National Emission Standards for Asbestos (40 CFR 61 Subpart B).

D. Comply with the local regulations of polychlorinated biphenyl (PCB). Since these chemicals are used in some existing insulation, existing fixed and vehicular transformers, assure proper marking, handling, and disposal of any PCB's in accordance with the regulations of 40 CFR 761.

1. Do not use PCB chemical substance, mixture, equipment, container, sealant, coating, or dust-control agent except in accordance with regulations of 40 CFR 761.
2. Immediately report any PCB chemical substance, mixture, equipment, container, sealant, coating, or dust control agent found stored within the project area to the Architect in writing and stop work in the area.

E. Lead paint is not present.

1.5 Asbestos is not present.

1.6 CONTROL AND DISPOSAL OF EXCESS MATERIAL, TRASH AND DEBRIS

A. Dispose of excess excavated material that is approved by the Architect/Engineer as clean fill onsite if an onsite soil disposal area is approved by the Architect/Engineer. If no such site is approved, dispose of the material in accordance with the provision of paragraph 1.5 (C).

B. Pick-up trash and place in containers. Empty containers on a regular schedule. Conduct handling and disposal to prevent contamination of the site and other areas. Do not dispose of in areas of natural vegetation. On completion, leave the area clean and natural looking.

C. Dispose of rubbish and debris as follows:
1. Transport all waste off the site and dispose of it in a manner that complies with State, and local requirements. Secure a permit or license prior to transporting any material off the site. Do not burn or bury waste materials on the site.

1.7 CONTROL AND DISPOSAL OF CHEMICAL AND SANITARY WASTES

A. Store chemical waste in corrosion-resistant containers, remove from the project site, and dispose of as necessary, but not less frequently than monthly. Provide for disposal of chemical waste in accordance with standard established practices as approved by the Architect. Dispose of lubricants to be discarded in accordance with approved procedures meeting state, and local regulations.

1.8 DUST CONTROL

A. Keep dust down at all times including nonworking hours, weekends, and holidays.

B. Secure and cover transport equipment and loose materials in transit to ensure that materials do not become airborne during transit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 56 00
SECTION 01 56 39 – TREE PROTECTION

PART 1 – GENERAL

1.1 SUMMARY

A. This section contains information about protecting existing trees from damage during the execution of any exterior work.

1.2 RELATED DOCUMENTS AND REFERENCES

A. Refer also to:
   2. ANSI A300-Tree Care Operations.

1.3 DESIGN REQUIREMENTS

A. Before the start of any activity that will disturb exterior site conditions, trees and plantings to be protected shall be clearly identified and approved by Owner’s Representative.

   1. Schedule a pre-construction meeting with the Owner’s Representative as per this Section’s contacts, prior to beginning any work, to review the execution of this Section relative to protecting and/or mitigating impacts to tree canopy and roots that are to remain and be protected. Pre-construction meeting shall consist of, but not be limited to, the following:
      a. General Contractor;
      b. ISA Certified Arborist;
      c. Subcontractor assigned to install Tree and Plant Protection measures;
      d. All subcontractors or site contractors that may be required to dig or trench into the soil;

   2. Trees that were not identified for removal, and that are damaged during the course of a project, will be replaced or mitigated by an ISA Certified Arborist at the contractor’s expense.
3. All canopy pruning, root pruning, branch tie back, tree removal, root pruning, and fertilizing required by this Section shall be performed by or under the direct supervision of an approved ISA Certified Arborist.

PART 2 – PRODUCTS

2.1 FENCING

A. 4 – 8’ high wood or metal fencing with posts no farther than 8’ OC (plastic, reflective fencing may be used with prior permission on a project by project basis; see also PART 3 EXECUTION).

2.2 SIGNS

A. Weather resistant, 8.5 x 11” reflective signs clearly stating ‘Tree preservation Area’ or approved equivalent.

2.3 MULCH

A. Double shredded, hardwood mulch, free from debris, non-dyed.

PART 3 – EXECUTION

3.0 PROTECTION FENCING

A. Trees identified for protection should have a 4 – 8’ high wood or metal fence securely installed at or beyond the trees’ drip line, delineating the protection zone, prior to any site disturbance or commencement of construction activity.

1. Plastic reflective snow fencing may be used for smaller projects of short duration

2. Fencing is to be maintained in a secure, upright position for the duration of the project or event, and repaired immediately if damaged.

3. If site access or project needs warrant a root protection zone smaller than the dripline of the tree, an ISA Certified Consulting Arborist, should be contracted to identify the minimum critical root zone that will preserve the tree along
with any additional treatments or injections that would be warranted in this situation.

C. Install 4-6” of natural non-dyed mulch over the protection zone for water retention. Do not place mulch within 6” of the base of the tree.

   1. Ensure a water source and specific contractor is identified to provide supplemental water, as needed, to root zone areas until tree protection can be removed.

D. Identify project lay-down areas, equipment and vehicle (etc.) storage away from protected trees.

E. Do not allow vehicle access over root zones of trees, if this area needs to be accessed temporarily, install 6 – 8” of mulch over entire root zone area along with 3/4” plywood to act as a bridge for vehicle access.

F. Protect trees from equipment or construction damage due to spillage, overhead branch damage from cranes, booms, machinery, etc.

   1. If, during the construction process, a conflict arises between project work scope and any part of a protected tree that could incur damage to the tree, work is to be stopped and the Owner’s Representative is to be immediately notified to determine how best to proceed without damage to the tree.

G. Do not allow any trenching, excavation or storage within the tree protection zone.

   1. If access to utilities, or other, is unavoidable near protected root zones, use boring or tunneling rather than trenching. An ISA Certified Consulting Arborist should be retained in a situation like this to perform any root pruning or mitigation of disturbance to ensure tree’s viability at the project’s expense.

H. Tree protection and associated mulch or materials are to be removed after completion of all project construction activities. Final review of tree health is to be performed by Owner’s Representative and an ISA Certified Consulting Arborist to determine if additional mitigation is needed.
4.1 Fencing Installed at Dripline of Tree

![Example of Wooden Tree Protection Fence](image)

2. Example: Tree Protection Sign used during the Harrington Dormitory Renovations, 2014.

![Example of Tree Protection Sign](image)
END OF SECTION
SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include but are not limited to the following:

1. Division 1 Section "References" for applicable industry standards for products specified.
2. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
3. Other included Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:

   a. Specification Section number and title.
   b. Generic name used in the Contract Documents.
   c. Proprietary name, model number, and similar designations.
   d. Manufacturer's name and address.
   e. Supplier's name and address.
   f. Installer's name and address.
   g. Projected delivery date or time span of delivery period.
   h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

   a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.

4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.

5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A at the end of this section.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
   a. Statement indicating why specified material or product cannot be provided.
   b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
   c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
   e. Samples, where applicable or requested.
   f. List of similar installations for completed projects with project names and addresses and addresses of architects and owners.
   g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
   h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
   i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
   j. Cost information, including a proposal of change, if any, in the Contract Sum.
   k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
   l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's/Engineer’s Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect/Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
   a. Form of Acceptance: Change Order.
   b. Use product specified if Architect/Engineer cannot make a decision on use of a proposed substitution within time allocated.

C. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Architect's Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product
request. Architect/Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."
b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect/Engineer will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 2 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
   a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
   b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect/Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
   1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   2. Requested substitution does not require extensive revisions to the Contract Documents.
   3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   4. Substitution request is fully documented and properly submitted.
   5. Requested substitution will not adversely affect Contractor's Construction Schedule.
   6. Requested substitution has received necessary approvals of authorities having jurisdiction.
   7. Requested substitution is compatible with other portions of the Work.
   8. Requested substitution has been coordinated with other portions of the Work.
   9. Requested substitution provides specified warranty.
   10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

A. Conditions: Architect/Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

5. Samples, if requested.

PART 3 - EXECUTION (Not Used)
SUBSTITUTION REQUEST
(After the Bidding/Negotiating Phase)

Project: ___________________________ Substitution Request Number: ___________________________

To: ___________________________ From: ___________________________

Date: ___________________________ A/E Project Number: ___________________________

Re: ___________________________ Contract For: ___________________________

Specification Title: ___________________________ Description: ___________________________

Section: ________ Page: ________ Article/Paragraph: ________

Proposed Substitution:

Manufacturer: ___________________________ Phone: ___________________________

Address: ___________________________

Trade Name: ___________________________ Model No.: ___________________________

Installer: ___________________________ Phone: ___________________________

Address: ___________________________

History: [ ] New product [ ] 1-4 years old [ ] 5-10 years old [ ] More than 10 years old

Differences between proposed substitution and specified product:

[ ] Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not recommending specified item:

Similar Installation:

Project: ___________________________ Architect: ___________________________

Address: ___________________________ Owner: ___________________________

Data Installed: ___________________________

Proposed substitution affects other parts of Work: [ ] No [ ] Yes; explain ___________________________

Savings to Owner for accepting substitution: ___________________________ ($ ________ )

Proposed substitution changes Contract Time: [ ] No [ ] Yes [Add] ________ [Deduct] ________ days.

Supporting Data Attached: [ ] Drawings [ ] Product Data [ ] Samples [ ] Tests [ ] Reports [ ]

© Copyright 2007, Construction Specifications Institute; 99 Canal Center Plaza, Suite 300, Alexandria, VA 22314

Page 1 of 2

Form Version: June 2004 CSI Form 13.1A
SUBSTITUTION REQUEST
(After the Bidding/Negotiating Phase — Continued)

The Undersigned certifies:
• Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
• Same warranty will be furnished for proposed substitution as for specified product.
• Same maintenance service and source of replacement parts, as applicable, is available.
• Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
• Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
• Proposed substitution does not affect dimensions and functional clearances.
• Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
• Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: ____________________________
Signed by: ______________________________
Firm: _________________________________
Address: _______________________________
Telephone: ____________________________
Attachments: __________________________

A/E's REVIEW AND ACTION

☐ Substitution approved - Make substitution in accordance with Specification Section 01 25 00 Substitution Procedures.
☐ Substitution approved as standard submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: _____________________________ Date: _____________________________

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E
☐ Other: ________________________________

END OF SECTION 01 60 00
SECTION 01 71 17 – ANIMAL MANAGEMENT REQUIREMENTS OF CONSTRUCTION

PART 1  GENERAL

1.1  SCOPE OF WORK

A. Animal Management requirements of construction are indicated at various areas of the Construction Documents. These requirements are general in nature, and indicate universal type details required to be constructed as part of the Base Contract Price for this Project. Inclusive of the requirements, the general contractor (GC) and all sub-contractors shall, as part of the Base Contract, do the following:

1. Hide all conduits, pipes, water lines, cables, utility lines, etc. or other loose construction at the minimum distance indicated in the Contract Documents, to avoid animal contact. Where this is not possible, the specified guard plates, or other protective devices shall be installed at no additional cost to the Base Contract Price.

2. Animals have been known to injure themselves due to items left in holding or exhibit spaces during construction. Each contractor is responsible for regularly removing all construction debris in compliance with this requirement for work in his/her area including, but not limited to nails, screws, wire, wood, metal scraps, welding rods, and other small fasteners or miscellaneous items.

3. Provide the special animal management requirements of construction wherever required as shown in the drawings or written into these Specifications.

B. The intent of these requirements is to ensure that the Owner obtains a facility in which Zoo personnel and animals may interact safely for the betterment of the entire facility. These requirements are not intended to cover all conditions that may arise during construction and the General Contractor shall cooperate with the Owner, Brandywine Zoo designated staff, and Architect/Landscape Architect during the construction period.

C. The General Contractor shall recognize that this facility is of unique construction and shall at all times take precaution to minimize the use of the Animal Management requirements as much as possible by thorough coordination of all the sub-trades involved, and through coordination of placement of all Work prior to installation throughout the Project, to minimize contact with animals on exhibit throughout the Zoo.
PART 2 PRODUCTS

2.1 GENERAL

A. Provide the materials shown in the drawings and notes where conditions require their respective use. See sheet CG – 101 for cover plates. Other shapes, not shown, might be required to accomplish the intended goal of animal protection.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all required items and/or perform all required work to create uniform and consistent conditions to the requirements of the Animal Management notes and details. This includes small, medium, and large indoor holding spaces and exterior yards.

END OF SECTION 01 71 17
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

2. General installation of products.
3. Coordination of Owner-installed products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Division 02 Section "Selective Demolition" for demolition and removal of selected portions of the building.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and
verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: 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 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, and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. 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.


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. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for foundations including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations from two or more locations.

D. 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 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 8 feet (2.4 m) in spaces without a suspended ceiling.

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. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect/engineer.
   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.

H. 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.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 OWNER-INSTALLED PRODUCTS

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

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
   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. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.
3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

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: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

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 assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
3.7 STARTING AND ADJUSTING

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

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

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

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 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. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00
SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the but are not limited to the following:

1. Division 2 Section "Selective Demolition" for demolition of selected portions of the building for alterations.

1.3 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety.

1. Primary operational systems and equipment.
2. Fire-protection systems.
3. Control systems.
4. Communication systems.
5. Electrical wiring systems.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, which results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Piping and ductwork.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting, and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.
B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering, and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete & Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.

5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 01 73 29
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 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.
   2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.

1.3 DEFINITIONS

A. Construction, Demolition and Land Clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodeling, alterations, repair, demolition, and land clearing. Includes material that is recycled, reused, salvaged, or disposed as garbage. Construction waste includes packaging.

B. 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.

C. Recycle: The process of sorting, treating and reconstituting materials for the purpose of using the material in the manufacture of a new product.

D. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include but are not limited to the following: Crushing or grinding of concrete for use as sub-base material. Chipping of land clearing debris for use of mulch.

E. Salvage: Recovery of demolition or construction waste and subsequent sale, reuse in another facility or sale to a third party.
F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

G. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the jobsite. The separated materials are hauled directly to a recycling facility or transfer station.

H. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.

I. Approved Recycling Facility: Any of the following:
   1. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.
   2. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent CDL waste by weight from the landfill by one or a combination of the following activities:
   1. Salvage.
   2. Reuse.

B. CDL waste materials that can be salvaged, reused, or recycled include, but are not limited to, the following:
   1. Demolition Waste:
      a. Asphalt paving.
      b. Concrete.
      c. Concrete reinforcing steel.
      d. Concrete masonry units.
      e. Doors and frames.
      f. Door hardware.
      g. Field office waste including office paper, cans, plastic, and office cardboard.
      h. Glazing.
      i. Gypsum board.
      j. Insulation.
      k. Land clearing debris (vegetation, stumpage, dirt, etc.).
      l. Membrane and built-up Roofing.
      m. Metals.
      n. Paint (through hazardous waste outlets).
o. Plastic film (sheeting, shrink wrap and packaging),
p. Plywood and oriented strand board.
q. Rough hardware.
r. Structural and miscellaneous steel.
s. Windows.
t. Wood.
u. Piping.
v. Supports and hangers.
w. Valves.
x. Mechanical equipment.
y. Refrigerants.
z. Electrical conduit.
aa. Copper wiring.
bb. Lighting fixtures.
c. Electrical devices.
dd. Transformers.

2. Construction Waste:

a. Acoustical ceiling tiles.
b. Concrete.
c. Concrete reinforcing steel.
d. Concrete masonry units.
e. Doors and frames.
f. Door hardware.
g. Field office waste including office paper, cans, plastic, and office cardboard.
h. Fluorescent lamps and ballasts.
i. Glazing.
j. Gypsum board.
k. Insulation.
l. Land clearing debris (vegetation, stumpage, dirt, etc.).
m. Membrane and built-up Roofing.
n. Metals.
o. Metal studs.
p. Paint (through hazardous waste outlets).
q. Plastic film (sheeting, shrink wrap and packaging),
r. Plywood and oriented strand board.
s. Rough hardware.
t. Structural and miscellaneous steel.
u. Windows.
v. Wood.
w. Piping.
x. Electrical conduit.
y. 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.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice of Award.

B. Waste Management Report: Submit report with each application for payment.

1.6 INFORMATIONAL SUBMITTALS

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

1. Material category.
2. Generation points of waste.
3. Total quantity of waste in tons (tonnes).
4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

C. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

D. 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.

E. 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.

F. Qualification Data: For refrigerant recovery technician.

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

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED Accredited Professional, certified by the USGBC as waste management coordinator.

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

C. Regulatory Requirements: Conduct construction waste management activities in accordance with hauling and disposal regulations of all authorities having jurisdiction and all other applicable laws and ordinances.

D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.
6. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.
   a. Owner.
   b. Architect/Engineer.
   c. Contractor's superintendent.
   d. Major subcontractors.
   e. Waste Management Coordinator.
   f. Other concerned parties.
7. Minutes: Record discussion. Distribute meeting minutes to all participants. Note: If there is an Architectural/Engineering consultant contracted by the State of Delaware, they will perform this role.

1.8 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. Distinguish between demolition and construction waste. 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. List all assumptions made for the quantity’s 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. The plan shall include the following information:

1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.
2. Proposed methods for CDL waste salvage, reuse, recycling, and disposal during demolition including, but not limited to, one or more of the following:
   a. Contracting with a deconstruction specialist to salvage materials generated,
   b. Selective salvage as part of demolition contractor’s work,
   c. Reuse of materials on-site or sale or donation to a third party.
3. Proposed methods for salvage, reuse, recycling, and disposal during construction including, but not limited to, one or more of the following:
   a. Requiring subcontractors to take their CDL waste to a recycling facility.
   b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility.
   c. Processing and reusing materials on-site.
   d. Self-hauling to a recycling or material recovery facility.
4. Name of recycling or material recovery facility receiving the CDL wastes.
5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on project site where materials separation will be located.

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. Including 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 CONSTRUCTION WASTE MANAGEMENT, GENERAL

A. Provide containers for CDL waste that is to be recycled clearly labeled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.

B. The collection containers for recyclable CDL waste must contain no more than 10% non-recyclable materials, by volume.

C. Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.

D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.

E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Ensure that subcontractors require the same provisions in their purchase agreements.

F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

A. General: Contractor shall separate recyclable materials from CDL waste to the maximum extent possible. Separate recyclable materials by type.

1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water and to minimize pest attraction. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.
3.4 REMOVAL OF CONSTRUCTION WASTE MATERIALS

A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.

B. Transport CDL waste materials off Owner's property and legally dispose of them.

C. Burning of CDL waste is not permitted.

<table>
<thead>
<tr>
<th>Material Category</th>
<th>Disposed in Municipal Solid Waste landfill</th>
<th>Diverted from Landfill by Recycling, Salvage or Reuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acoustical Ceiling Tiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Cardboard Packaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Drywall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. fluorescent Lamps and Ballasts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Land Clearing Debris (Vegetation, Stumpage &amp; dirt)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Paint (Through Hazardous Waste Outlets)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Plastic Film (Sheeting, Shrink Wrap &amp; Packaging)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Window Glass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Field Office waste (Office)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recycled</th>
<th>Salvaged</th>
<th>Reused</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>
<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>Paper, Aluminum Cans, Glass, Plastic and Coffee Cardboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Total (In Weight)</td>
<td>(TOTAL OF ALL ABOVE VALUES – IN WEIGHT)</td>
<td></td>
</tr>
<tr>
<td>Percentage of Waste Diverted</td>
<td>(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION 01 74 19
SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project Record Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Complete startup testing of systems.

8. Submit test/adjust/balance records.

9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

10. Advise Owner of changeover in heat and other utilities.

11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

12. Complete final cleaning requirements, including touchup painting.

13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect/Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect/Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect/Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."

2. Submit certified copy of Architect's/Engineer’s Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect/Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Submit pest-control final inspection report and warranty.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect/Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.

1.6 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect’s reference during normal working hours.

B. Record Drawings: Maintain and submit one original set of blue- or black-line white prints with two copies of Contract Drawings and Shop Drawings.

1. 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 prepare the marked-up Record Prints.
   a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
   d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
3. Mark important additional information that was either shown schematically or omitted from original Drawings.
4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy 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. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. Record Product Data: Submit three copies of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

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 Drawings, and Record Specifications, where applicable.

E. Miscellaneous Record Submittals: 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.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Assemble three complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Maintenance Data:
   a. Manufacturer's information, including list of spare parts.
   b. Name, address, and telephone number of Installer or supplier.
   c. Maintenance procedures.
   d. Maintenance and service schedules for preventive and routine maintenance.
   e. Maintenance record forms.
   f. Sources of spare parts and maintenance materials.
   g. Copies of maintenance service agreements.
   h. Copies of warranties and bonds.
B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.8 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

C. Provide additional copies of each warranty to include in each operation and maintenance manual.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances. Provide a magnetic sweep of all areas around the building to retrieve stray nails, screws and other fasteners or metal shards.

   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

   d. Remove tools, construction equipment, machinery, and surplus material from Project site.

   e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

   f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

   g. Sweep concrete floors broom clean in unoccupied spaces.

   h. Clean transparent materials, including glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

   i. Remove labels that are not permanent.

   j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

      1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

   k. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01 77 00
SECTION 01 78 23 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing maintenance manuals, including the following:

1. Maintenance documentation directory.
2. Maintenance manuals for the care and maintenance of products, and materials.

B. Related Sections include but are not limited to the following:

1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for maintenance manuals.
2. Division 1 Section "Closeout Procedures" for submitting maintenance manuals.
3. Division 1 Section "Project Record Documents" for preparing Record Drawings for maintenance manuals.
4. Divisions 02 through 33 Sections for specific maintenance manual requirements for the Work in those Sections.

1.3 SUBMITTALS

A. Final Submittal: Submit 1 copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Architect's/Engineer’s comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's/Engineer’s comments.

1.4 COORDINATION

A. Where maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.
PART 2 - PRODUCTS

2.1 MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. Table of contents.

B. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.

B. Title Page: Enclose title page in transparent plastic sleeve. 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, address, and telephone number of Contractor.
6. Name and address of Architect/Engineer.

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 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.

1. Binders: Heavy-duty, 3-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 "MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. 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 diskettes for computerized electronic equipment.


5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 PRODUCT MAINTENANCE MANUAL

A. 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.

B. 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.

C. 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.

D. 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.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. 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 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to operation and maintenance manuals.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.

1. 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.

E. 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.
2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

F. Comply with Division 1 Section "Closeout Procedures" for the schedule for submitting maintenance documentation.

END OF SECTION 01 78 23
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   
   A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

   B. Related Sections include but are not limited to the following:

   1. Division 1 Section “Closeout Procedures” for general closeout procedures and maintenance manual requirements.
   2. Division 1 Section “Operation and Maintenance Data” for operation and maintenance manual requirements.
   3. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 SUBMITTALS
   
   A. Record Drawings: Comply with the following:

   1. Number of Copies: Submit copies of Record Drawings as follows:

   a. Final Submittal: Submit three sets of marked-up Record Prints and one set of record transparencies. Print each Drawing, whether or not changes and additional information were recorded.

   B. Record Specifications: Submit three copies of Project's Specifications, including addenda and contract modifications.

   C. Record Product Data: Submit three copies of each Product Data submittal.

   1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as Record Product Data.
PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

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 prepare the 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 understandable drawing technique.

c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.

b. Revisions to details shown on Drawings.

c. Depths of foundations below first floor.

d. Locations and depths of underground utilities.

e. Revisions to routing of piping and conduits.

f. Revisions to electrical circuitry.

g. Actual equipment locations.

h. Duct size and routing.

i. Locations of concealed internal utilities.

j. Changes made by Change Order or Construction Change Directive.

k. Changes made following Architect's written orders.

l. Details not on the original Contract Drawings.

m. Field records for variable and concealed conditions.

n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the 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. Record Transparencies: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect. When authorized, prepare a full set of corrected transparencies of the Contract Drawings and Shop Drawings.

1. Incorporate changes and additional information previously marked on Record Prints. Erase, redraw, and add details and notations where applicable.
2. Refer instances of uncertainty to Architect for resolution.
3. Owner will furnish Contractor one set of transparencies of the Contract Drawings for use in recording information.
4. Print the Contract Drawings and Shop Drawings for use as Record Transparencies. Architect will make the Contract Drawings available to Contractor's print shop.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
3. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file.
4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect/Engineer.
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of the 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, Record Drawings, and Product Data where applicable.
2.3 RECORD PRODUCT DATA

A. 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 Drawings, and Product Data where applicable.

2.4 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.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's/Engineer's reference during normal working hours.

END OF SECTION 01 78 39
SECTIONS 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training videotapes.

B. See Divisions 2 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.2 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

B. Demonstration and Training CDs/Flash Drives: Submit two copies within seven days of end of each training module.

1.3 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Pre-instruction Conference: Conduct conference at Project site. Review methods and procedures related to demonstration and training.

D. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.
PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.

2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems, warranties and bonds; and maintenance service agreements.

3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.

4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.

5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.

6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.

7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.

8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
1. Owner will describe Owner's operational philosophy.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

3.2 DEMONSTRATION AND TRAINING RECORD

A. General: Engage a qualified commercial photographer to record demonstration and training sessions. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Format: Provide high-quality color video saved on CD’s or flash drives. Save in a format acceptable to the Owner.

C. Narration: Describe scenes on video by dubbing audio narration off-site after session is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

END OF SECTION 01 79 00
SECTION 02 32 00 - GEOTECHNICAL INVESTIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY


B. The Geotechnical Exploration and additional test report information is not part of this Contract but was used during the design phases.

1.3 SITE CONDITIONS

A. Site Information
   1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings.
   2. It is to be expressly understood that the Owner will not be responsible for interpretations or conclusions drawing there from by Contractor. Data is made available for convenience of Contractor.
   3. The locations of test borings at various points are shown in the report. While it is believed the results of the test boring accurately indicate the existing soil conditions below the surface at points and planes indicated, the Owner, the Architect, and Engineer assume no responsibility for the actual conditions which may be encountered in the execution of the contract.
   4. Additional test borings and other exploratory operations may be made by Bidder or Contractor at no cost to Owner.

1.4 WARRANTY

A. Neither the Owner, the Architect, or the Engineer, represent, warrant or guarantee that the materials actually encountered in the prosecution of the work, or any part thereof, will be of the same character as those indicated by the sample or logs of the test borings, and if the Contractor relies, for any purpose, upon the accuracy or completeness of said borings or log information, he does so at his own risk.
PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)
January 7, 2019

GWWO, Inc./Architects
800 Wyman Park Drive, Suite 300
Baltimore, Maryland 21211

Attn: Mr. Mark Lapointe, AIA

Re: Report of Geotechnical Exploration
   Brandywine Zoo - Quarantine Building and Lemur Lookout
   Wilmington, Delaware

Gentlemen:

   In accordance with our agreement, Geo-Technology Associates, Inc. (GTA) has performed a
geotechnical exploration for the proposed Quarantine Building and Lemur Lookout located at the
Brandywine Zoo, in Wilmington, Delaware. The subsurface exploration consisted of drilling test
borings, observing the excavation of test pits, and performing limited laboratory testing. The results
of the field and laboratory testing and geotechnical recommendations regarding design and
construction of the proposed structures are included in this report.

   We appreciate the opportunity to be of assistance on this project. Should you have questions
or require additional information, please contact our office at (302) 326-2100.

Very truly yours,

GEO-TECHNOLOGY ASSOCIATES, INC.

Christopher M. Reith, P.E.
Principal

CMR/amd
181154

cc: Amanda Zellers Moore, AIA; GWWO
   Kevin Rychlicki, AIA; DNREC

Attachments
BRANDYWINE ZOO - QUARANTINE BUILDING
AND LEMUR LOOKOUT
Wilmington, Delaware

January 2019

Prepared For:

GWWO, INC./ARCHITECTS
800 Wyman Park Drive, Suite 300
Baltimore, Maryland 21211

Attn: Mr. Mark Lapointe, AIA

Prepared By:

GEO-TECHNOLOGY ASSOCIATES, INC.
Geotechnical and Environmental Consultants
18 Boulden Circle, Suite 36
New Castle, Delaware 19720
(302) 326-2100

GTA Job No: 181154
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>SITE CONDITIONS</td>
<td>1</td>
</tr>
<tr>
<td>PROPOSED CONSTRUCTION</td>
<td>2</td>
</tr>
<tr>
<td>SITE GEOLOGY</td>
<td>2</td>
</tr>
<tr>
<td>SUBSURFACE EXPLORATION</td>
<td>3</td>
</tr>
<tr>
<td>SUBSURFACE CONDITIONS</td>
<td>4</td>
</tr>
<tr>
<td>LABORATORY TESTING</td>
<td>5</td>
</tr>
<tr>
<td>CONCLUSIONS AND RECOMMENDATIONS</td>
<td>5</td>
</tr>
<tr>
<td>Site Preparations</td>
<td>5</td>
</tr>
<tr>
<td>Earthwork</td>
<td>6</td>
</tr>
<tr>
<td>Foundations</td>
<td>7</td>
</tr>
<tr>
<td>Seismic Information</td>
<td>9</td>
</tr>
<tr>
<td>Slabs-on-Grade</td>
<td>9</td>
</tr>
<tr>
<td>Lateral Earth Pressure</td>
<td>10</td>
</tr>
<tr>
<td>Subsurface Utilities</td>
<td>11</td>
</tr>
<tr>
<td>ADDITIONAL SERVICES</td>
<td>12</td>
</tr>
<tr>
<td>LIMITATIONS</td>
<td>12</td>
</tr>
</tbody>
</table>

GBA - Important Information About Your Geotechnical Engineering Report

**APPENDICES**

Appendix A – Figures
- Figure 1 – Site Location Map
- Figures 2 & 3 – Exploration Location Plan

Appendix B – Subsurface Exploration Data
- Notes for Exploration Logs
- Test Boring Logs (B-1 through B-3; 4 Sheets)
- Test Pit Logs (TP-1 through TP-4, 4 Sheets)

Appendix C – Laboratory Testing
- Particle Size Distribution Report (1 Sheet)
INTRODUCTION

This report presents the results of the geotechnical exploration performed for the proposed Quarantine Building and Lemur Lookout located at the Brandywine Zoo in Wilmington, Delaware. Geo-Technology Associates, Inc. (GTA) was provided with a 4-sheet plan set titled Existing Conditions and Topographic Survey Plan prepared by CDA Engineering, Inc. dated November 8, 2018. In addition, an SD Design Draft plan set for the Lemur Lookout dated September 10, 2018 and 100% Final SD Set for the Zoo Support Facility dated September 18, 2018 were provided for our use in preparing this report. The plans depicted the existing site features and grading and general proposed layout of the structures. No other civil, structural, or architectural plans were provided for our review at the time this report was prepared.

The scope of this study included a field exploration, laboratory testing, and engineering analysis. Included in our field exploration were Standard Penetration Test (SPT) borings, drilled at 3 locations using a tri-pod drill rig within the proposed Lemur Lookout area to depths ranging from 4 to 12 feet below the existing ground surface. In addition, four test pits were excavated with the area of the proposed Quarantine Building to depths of 5 to 8½ feet. Limited laboratory testing was performed to characterize general subsurface conditions. The results of field and laboratory testing and preliminary geotechnical recommendations regarding the design and construction of the proposed structures are included in this report.

SITE CONDITIONS

The existing Brandywine Zoo is located off of North Van Buren Street and North Park Drive in Wilmington, Delaware, as indicated on the Site Location Map, Figure 1 included in Appendix A. The improvements are proposed at two separate areas within the existing zoo. The area for the Quarantine Building is generally a wooded hillside in an undeveloped portion of the zoo. The
existing Keeper Work Area building overlaps a portion of the proposed building footprint. An existing fence and a water line that was field marked but not shown on the plans are located within the proposed building footprint. A rock outcrop was visible in the south west portion of the building area. The existing grades range from about elevation (EL) 71 to EL 57 within the proposed building footprint.

The area for the Lemur Lookout overlaps the existing Llama and Rhea area within the zoo. Several retaining walls, sheds, underground and overhead utilities, fences, and a few mature trees are present in the area. The existing grades range from about EL 46 to EL 31 within the proposed building footprint. The invert of the 12-inch diameter VCP sanitary sewer pipe is shown to be EL 30.30, which is about 10 feet deep. No other inverts were shown on the plans.

**PROPOSED CONSTRUCTION**

The proposed Quarantine Building has a finished floor elevation of EL 56.50 and will be benched into the hillside. Retaining walls are also shown on the sides of the building. Excavations of up to 18 feet will be required to construct the foundations and a fill of about 3 feet will be required where the existing building is located to achieve the finish floor grade. The existing water line will need to be relocated outside of the building footprint.

The Lemur Lookout will consist of a two-story structure benched into the hillside with a service area. A mesh net cage connected to the building will provide an outdoor habitat area. The lower floor will be EL 34.0 and the upper floor will be EL 45.5. This will require excavations of up to about 12 feet for the foundations. About 3 feet of fill will be required in some areas to achieve the lower floor grade in the service area. The mesh structure will be supported by five 15- to 20-foot tall posts that will have tension guy wire anchors.

**SITE GEOLOGY**

According to the *Geologic Map of New Castle County*, prepared by the Delaware Geological Survey (DGS) in 2005, the site vicinity is located within the Piedmont Physiographic Province. Specifically, the map indicates the site is underlain by the Cambrian-Ordovician Age Brandywine
Blue Gneiss composed of medium- to coarse-grained granulates and gneisses composed of quartz and orthopyroxene. The residual soils typically consist of low to moderate plasticity silts, clays, and sands, with boulders often contained within the overburden soil and an irregular bedrock surface.

Based on the U.S. Department of Agriculture (USDA), *Natural Resources Conservation Service (NRCS) Web Soils Survey*, the soils underlying the site are generally mapped as Neshaminy–Montalto Silt Loams. The Neshaminy–Montalo Silt Loam is described as having surface areas covered with cobbles, stones or boulders with soils derived from the decomposition of the underlying bedrock. Depth to restrictive features range from 60 to 90 inches to reach bedrock. Refer to the publications for additional information.

**SUBSURFACE EXPLORATION**

GTA performed three tripod SPT borings and four test pits on December 6 and 10, 2018, respectively at approximate locations indicated on the attached Exploration Location Plan, Figures 2 and 3, included in Appendix A. The locations were selected by GTA based on accessibility with the equipment and utility conflicts. Tripod drilling equipment was used in the Lemur Lookout area due to access restrictions. A mini-excavator was used at the Quarantine Building location to access the steep and wooded hillside. The locations were estimated by measuring from existing site features and the elevations were interpolated from the topographic contours indicated on the referenced plans. Therefore, the locations, elevations, and depths of stratum changes should be considered approximate. Detailed descriptions of the encountered subsurface conditions are indicated on the Exploration Logs which are included in Appendix B.

Standard Penetration Testing (SPT) was performed in the tripod borings in general accordance with the procedures of ASTM D1586. Soil samples were obtained continuously within the boreholes. The Standard Penetration Test involves driving a 2-inch O.D., 1⅜-inch I.D. split-spoon sampler with a 140-pound hammer free-falling from a height of 30-inches. The number of blows required to drive the sampler was recorded in six-inch intervals. The SPT N-value, given as blows per foot, is defined as the total number of blows required to drive the sampler from the 6- to 18-inch interval.
Soil samples obtained from the borings were brought to GTA's laboratory for visual classification by a geotechnical engineer and limited laboratory testing. The descriptions provided on the logs are based on visual observations of the samples using the Unified Soil Classification System as summarized in the Notes for Exploration Logs included in Appendix B, supplemented by the laboratory test results.

**SUBSURFACE CONDITIONS**

No topsoil was present at the boring locations in the existing Llama pen. About 10 to 18 inches of topsoil, root mat, or forest litter were encountered at the location of the test pits. Existing fill was encountered in two of the borings to depths of about 1 to 2 feet and is believed to be backfill behind the retaining walls to terrace the site. The fill visually classified as sandy silt.

Underlying the surficial materials, the borings encountered residual soil visually classifying as lean clay, silt, or silty sand with varying amounts of gravel and cobble size rock fragments. The residual soil exhibited uncorrected CPT N-values generally ranging from 6 to 49 blows per foot (bpf), although spoon refusal was encountered in a few locations. Boring B-2A encountered refusal on a cobble at a depth of 2.4 feet and was off-set two feet west and re-drilled as Boring B-2B. The borings encountered refusal at depths of 8 feet in B-1 and 4 feet in B-3. Boring B-2B was terminated a depth of 12 feet.

The test pits encountered residual soil visually classifying as silt with sand, containing varying amounts of gravel and cobble size rock fragments. The test pits encountered difficult excavation in material described as highly weathered rock at depths of about 4 to 7½ feet. Practical refusal was encountered after excavating ½- to 1-foot into the highly weathered rock at depth of 5 to 8 feet.

Water was encountered in two of the borings at depths of 1 and 3.9 feet. Water was encountered in two of the test pits at depths of 3 and 8 feet. The holes were backfilled upon completion for safety consideration so 24-hour water levels were not obtained. It should be anticipated that seepage of water may be encountered perched atop hydraulically restrictive soils,
trapped within locally more permeable soil zones, at the soil/bedrock interface, and from within fractures in the bedrock.

LABORATORY TESTING

Samples recovered from the borings were submitted for limited laboratory testing consisting of grain-size analysis, Atterberg Limits, and natural moisture content. The grain-size analysis and Atterberg Limit testing were performed to determine the Unified Soil Classification System (USCS) designation for the soil. The USCS classifications provide information regarding soils engineering behavior. The results of testing are summarized in the following table, and the detailed test reports are included in Appendix C.

### SUMMARY OF SOIL LABORATORY TESTING

<table>
<thead>
<tr>
<th>BORING</th>
<th>DEPTH (ft)</th>
<th>USCS</th>
<th>LL%</th>
<th>PI%</th>
<th>NMC%</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>4 - 6</td>
<td>Silty SAND (SM)</td>
<td>43</td>
<td>16</td>
<td>33.1</td>
</tr>
</tbody>
</table>

LL=Liquid Limit; PI=Plasticity Index; NMC=Natural Moisture Content

CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of this study, it is our opinion that construction of the proposed improvements is feasible, given that the following geotechnical recommendations are observed, and that the standard level of care is maintained during construction. It should be noted that problems could be encountered related to difficult excavation/rock excavation, seepage of water from excavations, and moisture sensitive soils. A discussion of this issue and general site development procedures are included in the following paragraphs.

Site Preparations

Prior to construction, the site areas should be cleared and stripped of topsoil and vegetation. Bulk fills are not anticipated; however, the foundation walls and any new utilities will require backfill. The materials generated from foundation excavations can be re-used as backfill as long as vegetation and rock fragments larger than three inches are removed. The materials can be stockpiled on-site and should be protected from weather since the fine-grained materials are moisture sensitive. If this is not practical, granular off-site borrow meeting the Unified Soil Classification System (USCS) soil types of Silty SAND (SM) or Silty GRAVEL (GM) should be used.
Highly weathered rock was encountered at depths of 4 to 7½ feet. It should be anticipated that rock removal techniques will be required where the excavations to achieve the proposed grading or to install utilities or foundations will extend below the refusal levels. Typically materials with an SPT blow count of up to 50 blows for 4 inches of penetration can be excavated by conventional heavy equipment equipped with rippers or rock teeth in open cuts. The highly weathered rock likely will be difficult or impractical to excavate with smaller equipment and in confined trenches.

The excavated highly weathered rock will likely result in large particle sizes (cobbles and boulders) that will not be suitable for re-use as fill without processing. This could impact the cut/fill balance. The maximum particle size in structural fills should generally be limited to 6 inches or less for mass fills and 3 inches or less if used to backfill utilities, walls, or foundations.

Seepage of water will likely be encountered in the cut slopes during grading. Blanket drains or toe drains should be installed to intercept seepage, where encountered, to collect and direct water away from the work areas during construction. Permanent drains should be tied into the stormwater system to prevent hydrostatic pressure from building up behind basement walls and retaining walls and to reduce the potential for icing conditions during winter months.

Earthwork

The preliminary plans indicate that excavations will need to be made to construct the buildings. Cuts of up to 18 feet for the Quarantine Building and 12 feet for the Lemur Lookout will be required during grading. The placement of fill may be required to achieve the floor subgrade elevations in the lowest areas of the buildings. Topsoil should generally be stripped a minimum of 5 feet beyond the proposed building limits. Following stripping of topsoil, fill areas should be proof-rolled or evaluated to locate any soft or loose areas on the fill subgrade prior to fill placement. Areas that exhibit instability should be vertically over-excavated to suitable natural soils; dried and recompacted in place; or stabilized as appropriate. The stripping of organics, proofrolling, undercutting of unsuitable material, and placement of structural fill should be observed by a Geotechnical Engineer or their qualified representative.
Upon satisfactory evaluation of the subgrade, structural fill should be placed in lifts and compacted in accordance with the specifications included in this report. The fill materials will typically need to be within 2 to 3 percentage points of the optimum moisture content before compactive effort is applied. The on-site soils varied in consistency. These soils can possibly be reused for backfill; however, moisture conditioning will likely be required to achieve the specified compaction. In addition, some segregation of deleterious materials and larger rock fragments will likely be required. All structural fill should be constructed in maximum 8- to 10-inch thick loose lifts and be compacted to 95 percent of the Standard Proctor maximum dry density, with moisture contents within 3 percentage points of optimum for compaction.

Fill subgrades and each lift of fill should be observed and tested by a soils technician on a full-time basis, under the supervision of a registered engineer as required per the International Building Code. All compactive effort should be verified by in-place density testing. New fills constructed on slopes steeper than 5H:1V (horizontal to vertical) should be keyed into existing slopes for stability considerations. All fill slopes steeper than 5H:1V should generally be placed as structural fill and be controlled and compacted to minimum densities as specified above. Slopes constructed steeper than 3H:1V should be evaluated for stability and may need to be designed with reinforcement.

We recommend that positive drainage be maintained across the site during construction to prevent ponding of water, since the exposed subgrades could destabilize in combination with construction traffic and precipitation. If the subgrade is disturbed by construction traffic and becomes unstable, undercutting and replacement of these surficial materials will likely be required.

**Foundations**

Based on the subsurface conditions, the proposed improvements may be supported on shallow spread footings designed for a maximum net allowable bearing pressure of 3,000 pounds per square foot (psf). Minimum widths for wall footings of 24 inches and column footings of 36 inches are recommended when design based on 3,000 psf results in a more narrow footing.
No specific information was provided regarding the proposed foundations at the five mast locations or guy anchors for the outdoor exhibit. GTA anticipates the proposed footings for the masts will consist of drilled piers or spread footings. If drilled piers are used, they should be a minimum of 30 inches in diameter and should be designed to resist over-turning using the presumptive lateral bearing value of 100 psf/ft in the soil. We anticipate that guy anchors will be socketed into highly weathered rock or fresh rock. Grouted anchors should be used in the rock due to the variable weathering and temporary casing will likely be required during drilling and installation. Additional analysis and details can be provided if lateral forces control design.

Settlement of up to 1-inch total and up to ½-inch differential can be anticipated given the variable bearing conditions. New footings should be founded a minimum of 32 inches below the existing grades to provide protection from frost action unless they are supported directly on non-frost susceptible material (fresh rock). Where new footings will abut existing structures, they should be set at the same grade. Footings can be stepped up or down at 2 horizontal to 1 vertical to accommodate any grade changes.

Footings should be supported on medium stiff to stiff natural soils. Rock fragments and highly weathered rock materials were encountered within the explored locations. Highly weathered rock was encountered at depths of about 4 to 7½ feet. Based on previous explorations within this geologic formation, the rock surface can be highly irregular with the presence of large boulders in the soil matrix. Should a boulder or rock be encountered within the excavation of new foundations, the condition should be evaluated by the geotechnical engineer. If soft/loose soils or existing fill is encountered at the footing subgrade, the unsuitable material should be undercut to suitable natural soils. The undercut volume can be backfilled with AASHTO #57 stone or additional concrete.

Detailed foundation excavation evaluations should be performed in each footing excavation prior to the placement of crushed stone, reinforcing steel, or concrete. These evaluations should be performed by a representative of the registered Geotechnical Engineer to confirm that the design allowable soil bearing pressure is available. The foundation bearing surface evaluations should be
performed using a combination of visual observation, hand-rod probing, and Dynamic Cone Penetrometer (DCP) testing, as applicable.

Seismic Information

The soil conditions at this site can be categorized as Site Class C per the 2015 International Building Code and ASCE 7-10. This categorization is based on the subsurface exploration data, general geologic information for the region, and the information contained in the code.

Slabs-on-Grade

Floor slabs can be designed as concrete slabs-on-grade. Based on the results of the field and laboratory analysis, we recommend that the design of the floor slabs be based on a subgrade modulus of 100 pounds per cubic inch (pci). GTA recommends that the concrete floor slabs supported on-grade be founded on a minimum 4-inch thick open-graded coarse granular layer to act as a capillary break. A polyethylene vapor retarder should be installed in accordance with ACI and ASTM guidelines to interrupt the rise of moisture through the slab if moisture-sensitive floor coverings are planned. The slabs may bear on footing projections, but they should be jointed so that the foundation walls can settle independently from the slab.

Below slab utility trench backfill and wall backfill supporting slabs-on-grade should be considered structural fill and meet the compaction requirements specified in the Earthwork section of this report. Construction activities and exposure to weather often cause deterioration of slab subgrades. The contractor should exercise care during floor slab preparation to limit disturbance to exposed subgrades. We recommend that the slab subgrade soils be evaluated by a representative of the Geotechnical Engineer immediately prior to stone and concrete placement. This evaluation may include a combination of visual observations, proofrolling, hand-rod probing, and field density tests to verify that the subgrade soils have been prepared properly. If soft or loose soils are encountered, recommendations for remedial measures should be provided by the geotechnical engineer at the time of construction.
Lateral Earth Pressure

Below grade building walls and retaining walls will be required for these structures. These walls should be designed to resist the pressures from the retained soils. Walls that are braced to prevent rotation should be designed for at-rest earth pressures. Walls that are free to rotate can be designed for active earth pressures. Assuming the use of the on-site soils, with a plasticity index of 15 or less, or off-site granular borrow placed and compacted as structural fill, we recommend below grade walls be designed using the values tabulated below.

<table>
<thead>
<tr>
<th>Soil Property</th>
<th>Recommended Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Weight, $\gamma_m$</td>
<td>125 pcf</td>
</tr>
<tr>
<td>Angle of Internal Friction, $\Phi$</td>
<td>28°</td>
</tr>
<tr>
<td>Plasticity Index (PI)</td>
<td>&lt;15</td>
</tr>
<tr>
<td>Coefficient of Active Earth Pressure (Ka)</td>
<td>0.36</td>
</tr>
<tr>
<td>Coefficient of Passive Earth Pressure (Kp)</td>
<td>2.77</td>
</tr>
<tr>
<td>Coefficient of Earth Pressure at Rest (Ko)</td>
<td>0.53</td>
</tr>
<tr>
<td>Base Friction, $\tan \delta$</td>
<td>0.4</td>
</tr>
<tr>
<td>Equivalent Fluid Pressure (Unrestrained Top of Wall)</td>
<td>45 psf/ft</td>
</tr>
<tr>
<td>Equivalent Fluid Pressure (Restrained Top of Wall)</td>
<td>65 psf/ft</td>
</tr>
</tbody>
</table>

Wall backfill should be free of organic matter, rocks greater than 3 inches in diameter, and construction debris. Backfill should be placed and compacted in lifts in a manner that does not damage the foundation or waterproofing. Additionally, foundation wall backfill should not be placed until the concrete has achieved adequate strength and the structure is braced per the design requirements.

At a minimum, we recommend that commercial composite drainage panels and a perimeter drain be provided behind below grade walls to carry away any infiltrating surface water so that hydrostatic pressures do not develop. The perimeter drain should consist of a 4-inch-diameter slotted or perforated pipe encased in a minimum of 6 inches of crushed stone and be wrapped by a geotextile filter. The crushed stone should meet the gradational requirements of AASHTO Size No. 57 or 78 aggregate. The perimeter drain should tie into weep holes, a sump pit, adjacent storm sewer, or off-site drainage system. All below-grade walls adjacent to occupied spaces should be waterproofed.
Subsurface Utilities

GTA has not been provided with information regarding proposed below grade utilities; however, we offer the following general recommendations for construction of below grade utilities. The natural soils are considered suitable for support of subsurface utilities. GTA recommends a minimum 6-inch-thick granular bedding be placed where rock or soft conditions are encountered to provide uniform support as dictated by site conditions or as required by local code. Based on the results of the explorations, GTA anticipates that excavations of 5 to 8 feet may be accomplished using standard utility construction equipment, unless boulders or bedrock are encountered. Deeper excavations will likely require rock excavation techniques. Splitting or fracturing of the boulders or rock using chemical expansion agents may be required depending on the final inverts. An excavator equipped with rock teeth or a rock hammer will be less efficient than mechanical or chemical splitting.

Based on the subsurface data, water was encountered at depths as shallow as 1 to 3 feet so perched water will likely be encountered in utility excavations. Problems associated with groundwater include seepage into the excavation, loss of stability, sidewall collapse, and sloughing of soils. These problems can be reduced through the use of sumps and pumps. Trench shields may also be required for support of vertical cut excavations where utilities are deeper than 4 feet to reduce sidewall collapse. Due to the potential for collapse of unsupported excavation in granular soils, the utility contractor should be prepared to provide adequate earth support systems during utility construction. All excavations should be sloped or shored in accordance with current OSHA safety regulations. Dewatering through the use of “sump and pump” techniques would most likely be adequate for excavations if seepage or perched water is encountered.

Utility excavations in structural areas should be backfilled and compacted as recommended in the Earthwork section of this report. Depending on the soil moisture content at the time of construction, moisture conditioning or off-site borrow may be required to attain the required compaction.
ADDITIONAL SERVICES

We recommended that during final design and construction of the subject project, a geotechnical engineer be retained to provide additional consultation and observation and testing services for the following items.

- Review final civil and structural plans to evaluate if our recommendations have been implemented.
- Provide observation and testing services during site work and foundation construction to evaluate if the work is being performed in accordance with the project specifications and intent of this report.
- Provide Special Inspections as required by the project specifications and City of Wilmington Department of Licensing and Inspections.

LIMITATIONS

This report, including all supporting exploration logs, field data, field notes, laboratory test data, calculations, estimates, and other documents prepared by GTA in connection with this project, has been prepared for the exclusive use of GWWO, Inc./Architects pursuant to the agreement between GTA and GWWO, Inc./Architects and in accordance with generally accepted engineering practice. All terms and conditions set forth in the Agreement and the General Provisions attached thereto are incorporated herein by reference. No warranty, express or implied, is given herein. Use and reproduction of this report by any other person without the expressed written permission of GTA and GWWO, Inc./Architects is unauthorized and such use is at the sole risk of the user.

The analysis and recommendations contained in this report are based on the data obtained from limited observation and testing of the encountered materials. Borings and test pits indicate soil conditions only at specific locations and times and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between the explored locations. Consequently, the analysis and recommendations must be considered preliminary until the subsurface conditions can be verified by direct observation at the time of construction. If variations in subsurface conditions from those described are noted during construction, recommendations in this report may need to be re-evaluated.
In the event that any changes in the nature of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report are verified in writing. Geo-Technology Associates, Inc. is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analysis without the expressed, written authorization of Geo-Technology Associates, Inc.

The subject matter of this report is limited to the facts and matters stated herein. Absence of a reference to any other conditions or subject matter shall not be construed by the reader to imply approval by the writer.
Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects
Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared solely for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report
Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors
Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client’s goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:
• not prepared for you;
• not prepared for your project;
• not prepared for the specific site explored; or
• completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:
• the function of the proposed structure, as when it’s changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
• the elevation, configuration, location, orientation, or weight of the proposed structure;
• the composition of the design team; or
• project ownership.

As a general rule, always inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

Subsurface Conditions Can Change
A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. Do not rely on a geotechnical-engineering report whose adequacy may have been affected by: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. Contact the geotechnical engineer before applying this report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions
Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report’s Recommendations Are Not Final
Do not overrely on the confirmation-dependent recommendations included in your report. Confirmation-dependent recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report’s confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations’ applicability.

A Geotechnical-Engineering Report Is Subject to Misinterpretation
Other design-team members’ misinterpretation of geotechnical-engineering reports has resulted in costly
problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team’s plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

**Do Not Redraw the Engineer’s Logs**
Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

**Give Constructors a Complete Report and Guidance**
Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, but prefix it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report’s accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure constructors have sufficient time to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

**Read Responsibility Provisions Closely**
Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

**Environmental Concerns Are Not Covered**
The equipment, techniques, and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. Do not rely on an environmental report prepared for someone else.

**Obtain Professional Assistance To Deal with Mold**
Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; none of the services performed in connection with the geotechnical engineer’s study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.

**Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance**
Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.
Notes:

1) Base map obtained from Google Earth Aerial Imagery from August, 2016.
EXPLORATION LOCATION PLAN
BRANDYWINE ZOO
WILMINGTON, DELAWARE

JOB NUMBER: 181154
FIGURE: 2
REVIEW BY: CMR
SCALE: NTS
DATE: DEC 2018

Key:
- Number and approximate location of soil borings performed for this study

Notes:
1. Layout was obtained from sheet V-100, Existing Conditions Topographic Survey Plan by CDA Engineering, Inc., dated November 8, 2018.
2. Exploration Location Plan should be read together with GTA Brandywine Zoo, Job No.181154 for complete evaluation.
Notes:
(1) Base map obtained from Sheet ST100, Site Layout and Grading Plan, dated 9/18/18.
(2) Exploration Location Plan should be read together with GTA Report Job No. 181154 for complete evaluation. Use of the diagram is limited illustration of the approximate locations of the explorations.
NOTES FOR EXPLORATION LOGS

KEY TO USCS TERMINOLOGY AND GRAPHIC SYMBOLS

<table>
<thead>
<tr>
<th>MAJOR DIVISIONS (BASED UPON ASTM D 2488)</th>
<th>SYMBOLS GRAPHIC LETTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>COARSE-GRAINED SOILS</td>
<td></td>
</tr>
<tr>
<td>CLEAN GRAVELS</td>
<td>GW</td>
</tr>
<tr>
<td>LESS THAN 5% PASSING THE NO. 200 SIEVE</td>
<td></td>
</tr>
<tr>
<td>GRAVELS WITH FINES</td>
<td>GP</td>
</tr>
<tr>
<td>MORE THAN 15% PASSING THE NO. 200 SIEVE</td>
<td></td>
</tr>
<tr>
<td>SAND AND SANDY SOILS</td>
<td>SP</td>
</tr>
<tr>
<td>MORE THAN 50% OF COARSE FRACTION</td>
<td></td>
</tr>
<tr>
<td>RETAINED ON NO. 4 SIEVE</td>
<td></td>
</tr>
<tr>
<td>SANDS WITH FINES</td>
<td>SC</td>
</tr>
<tr>
<td>MORE THAN 15% PASSING THE NO. 200 SIEVE</td>
<td></td>
</tr>
<tr>
<td>SILT OR CLAY</td>
<td>ML</td>
</tr>
<tr>
<td>(&lt;15% RETAINED THE NO. 200 SIEVE)</td>
<td></td>
</tr>
<tr>
<td>Silt or Clay with sand or gravel</td>
<td></td>
</tr>
<tr>
<td>(15% TO 30% RETAINED THE NO. 200 SIEVE)</td>
<td></td>
</tr>
<tr>
<td>SANDS OR GRAVELY SILT OR CLAY</td>
<td>OL</td>
</tr>
<tr>
<td>(&gt;30% RETAINED THE NO. 200 SIEVE)</td>
<td></td>
</tr>
<tr>
<td>FINE-GRAINED SOILS</td>
<td></td>
</tr>
<tr>
<td>LIQUID LIMIT LESS THAN 50</td>
<td></td>
</tr>
<tr>
<td>SILT OR CLAY</td>
<td>MH</td>
</tr>
<tr>
<td>(&lt;15% RETAINED THE NO. 200 SIEVE)</td>
<td></td>
</tr>
<tr>
<td>SILT OR CLAY WITH SAND OR GRAVEL</td>
<td></td>
</tr>
<tr>
<td>(15% TO 30% RETAINED THE NO. 200 SIEVE)</td>
<td></td>
</tr>
<tr>
<td>SANDY OR GRAVELY SILT OR CLAY</td>
<td>CH</td>
</tr>
<tr>
<td>(&gt;30% RETAINED THE NO. 200 SIEVE)</td>
<td></td>
</tr>
<tr>
<td>HIGHLY ORGANIC SOILS</td>
<td>PT</td>
</tr>
</tbody>
</table>

NOTES: DUAL SYMBOLS ARE USED TO INDICATE COARSE-GRAINED SOILS CONTAINING AN ESTIMATED 10% FINES BY VISUAL CLASSIFICATION OR WHEN THE SOIL HAS A LIQUID LIMIT OF 6 FEET OR MORE, 15 PERCENT FINES FROM LABORATORY TESTS, AND FOR FINE-GRAINED SOILS WHEN THE PLASTICITY INDEX AND LIQUID LIMIT VALUES FALL IN THE PLASTICITY CHART'S CROSSHALED AREA. RESULTS OF LABORATORY TESTING ARE USED TO SUPPLEMENT THE CLASSIFICATION OF THE SOILS BASED ON THE VISUAL-MANUAL PROCEDURES OF ASTM D2488.

ADDITIONAL TERMINOLOGY AND GRAPHIC SYMBOLS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>SYMBOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDITIONAL DESIGNATION</td>
<td></td>
</tr>
<tr>
<td>TOPSOIL</td>
<td></td>
</tr>
<tr>
<td>MAN-MADE FILL</td>
<td></td>
</tr>
<tr>
<td>GLACIAL TILL</td>
<td></td>
</tr>
<tr>
<td>COBBLES AND BOULDERS</td>
<td></td>
</tr>
<tr>
<td>RESIDUAL SOIL DESIGNATION</td>
<td>&quot;N&quot; VALUE</td>
</tr>
<tr>
<td>HIGHLY WEATHERED ROCK</td>
<td>50 TO 50/1&quot;</td>
</tr>
<tr>
<td>PARTIALLY WEATHERED ROCK</td>
<td>MORE THAN 50 BLOWS FOR 1&quot; PENETRATION, AUGER PENETRABLE</td>
</tr>
</tbody>
</table>

COARSE-GRAINED SOILS (GRAVEL AND SAND)

<table>
<thead>
<tr>
<th>DESIGNATION</th>
<th>BLOWS PER FOOT (BPF) &quot;N&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY LOOSE</td>
<td>0 - 4</td>
</tr>
<tr>
<td>LOOSE</td>
<td>5 - 10</td>
</tr>
<tr>
<td>MEDIUM DENSE</td>
<td>11 - 30</td>
</tr>
<tr>
<td>DENSE</td>
<td>31 - 50</td>
</tr>
<tr>
<td>VERY DENSE</td>
<td>&gt;50</td>
</tr>
</tbody>
</table>

NOTE: "N" VALUE DETERMINED AS PER ASTM D1586

FINE-GRAINED SOILS (SILT AND CLAY)

<table>
<thead>
<tr>
<th>CONSISTENCY</th>
<th>BPF &quot;N&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY SOFT</td>
<td>&lt;2</td>
</tr>
<tr>
<td>SOFT</td>
<td>2 - 4</td>
</tr>
<tr>
<td>MEDIUM STIFF</td>
<td>5 - 8</td>
</tr>
<tr>
<td>STIFF</td>
<td>9 - 15</td>
</tr>
<tr>
<td>VERY STIFF</td>
<td>16 - 30</td>
</tr>
<tr>
<td>HARD</td>
<td>&gt;30</td>
</tr>
</tbody>
</table>

NOTE: ADDITIONAL DESIGNATIONS TO ADVANCE SAMPLER INDICATED IN BLOW COUNT COLUMN: WOH = WEIGHT OF HAMMER WOR = WEIGHT OF ROD(S)

SAMPLE TYPE

<table>
<thead>
<tr>
<th>DESIGNATION</th>
<th>SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPLIT-SPOON</td>
<td>S-</td>
</tr>
<tr>
<td>SHELBY TUBE</td>
<td>U-</td>
</tr>
<tr>
<td>ROCK CORE</td>
<td>R-</td>
</tr>
</tbody>
</table>

WATER DESIGNATION

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENCOUNTERED DURING DRILLING</td>
<td></td>
</tr>
<tr>
<td>UPON COMPLETION OF DRILLING</td>
<td></td>
</tr>
<tr>
<td>24 HOURS AFTER COMPLETION</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: WATER OBSERVATIONS WERE MADE AT THE TIME INDICATED. POROSITY OF SOIL STRATA, WEATHER CONDITIONS, SITE TOPOGRAPHY, ETC. MAY CAUSE WATER LEVEL CHANGES.
**LOG OF BORING NO. B-1**

**PROJECT:** Brandywine Zoo  
**PROJECT NO.:** 181154  
**PROJECT LOCATION:** Wilmington, Delaware

**DATE STARTED:** 12/6/18  
**DATE COMPLETED:** 12/6/18  
**DRILLING CONTRACTOR:** GTA  
**DRILLER:** D. Hans, Jr.  
**DRILLING METHOD:** Tripod  
**SAMPLING METHOD:** Split Spoon

**WATER ENCOUNTERED DURING DRILLING (ft):** 1.0  
**GROUND SURFACE ELEVATION:** 33.5

<table>
<thead>
<tr>
<th>SAMPLE NUMBER</th>
<th>SAMPLE DEPTH (ft.)</th>
<th>SAMPLE RECOVERY (in.)</th>
<th>SAMPLE BLOW/S/6 inches</th>
<th>N (blows/ft.)</th>
<th>ELEVATION (ft.)</th>
<th>USCS GRAPHIC SYMBOL</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>0.0</td>
<td>12</td>
<td>2-3-3-3</td>
<td>6</td>
<td>33.5</td>
<td>FILL</td>
<td>Dark brown, moist, medium stiff, sandy silt FILL</td>
<td></td>
</tr>
<tr>
<td>S-2</td>
<td>2.0</td>
<td>4</td>
<td>4-50/2&quot;</td>
<td></td>
<td>31.5</td>
<td>SM</td>
<td>Brown, orange, test black, moist, dense, Silty SAND</td>
<td></td>
</tr>
<tr>
<td>S-3</td>
<td>4.0</td>
<td>24</td>
<td>2-7-11-13</td>
<td>18</td>
<td></td>
<td></td>
<td>Same, medium dense</td>
<td></td>
</tr>
<tr>
<td>S-4</td>
<td>6.0</td>
<td>18</td>
<td>18-19-23-50/4&quot;*</td>
<td>42</td>
<td>25.5</td>
<td></td>
<td>Same, dense</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:** Elevation and location should be considered approximate.

**LOG OF BORING NO. B-1**

18 Boulden Circle, Suite 36  
New Castle, DE 19720

**Sheet 1 of 1**
**LOG OF BORING NO. B-2A**

**PROJECT:** Brandywine Zoo  
**PROJECT NO.:** 181154  
**PROJECT LOCATION:** Wilmington, Delaware

**DATE STARTED:** 12/6/18  
**DATE COMPLETED:** 12/6/18  
**DRILLING CONTRACTOR:** GTA  
**DRILLER:** D. Hans, Jr.  
**DRILLING METHOD:** Tripod  
**SAMPLING METHOD:** Split Spoon

**WATER LEVEL (ft.):** Dry  
**WATER ENCOUNTERED DURING DRILLING (ft):** Dry  
**GROUND SURFACE ELEVATION:** 32.4  
**CAVED (ft.):** 1.5

### Sample Log

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Sample Depth (ft.)</th>
<th>Sample Recovery (in.)</th>
<th>Sample Depth 6 inches</th>
<th>Elev. (ft.)</th>
<th>USCS</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>0.0</td>
<td>14</td>
<td>5-5-5-5</td>
<td>32.4</td>
<td>SM</td>
<td>FILL</td>
<td>Dark brown, moist, stiff, sandy silt FILL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-2</td>
<td>2.0</td>
<td>NR</td>
<td>50/5&quot;</td>
<td>30.0</td>
<td></td>
<td></td>
<td>Brown, orange, and black, moist dense, Silty SAND</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No Recovery</td>
<td></td>
</tr>
</tbody>
</table>

**ELEVATION AND LOCATION SHOULD BE CONSIDERED APPROXIMATE.**

**NOTES:**

**DRILLING METHOD:** Tripod

**LOGGED BY:** K. Kershaw  
**CHECKED BY:** C. Reith

---

**GEO-TECHNOLOGY ASSOCIATES, INC.**

18 Boulden Circle, Suite 36  
New Castle, DE 19720

Sheet 1 of 1
# LOG OF BORING NO. B-2B

**PROJECT:** Brandywine Zoo  
**PROJECT NO.:** 181154  
**PROJECT LOCATION:** Wilmington, Delaware

**WATER LEVEL (ft):** 3.9  
**DATE:** 12/6/18  
**CAVED (ft):** 9.4  
**DATE:** 12/6/18

**DATE STARTED:** 12/6/18  
**DATE COMPLETED:** 12/6/18  
**DRILLING CONTRACTOR:** GTA  
**DRILLER:** D. Hans, Jr.  
**DRILLING METHOD:** Tripod  
**SAMPLING METHOD:** Split Spoon

<table>
<thead>
<tr>
<th>SAMPLE NUMBER</th>
<th>SAMPLE DEPTH (ft)</th>
<th>SAMPLE RECOVERY (in)</th>
<th>BLOW/S 6 inches</th>
<th>N (blows/ft)</th>
<th>ELEVATION (ft)</th>
<th>USCS</th>
<th>GRAPHIC SYMBOL</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>2.0</td>
<td>8</td>
<td>23-19-20-31</td>
<td>39</td>
<td>31.2</td>
<td>SM</td>
<td></td>
<td>Brown, orange, text black, moist, dense, Silty SAND with rock fragments</td>
<td>Hand augered to 2.0 feet; Hand cleared cobbles at 2.0 feet</td>
</tr>
<tr>
<td>S-2</td>
<td>4.0</td>
<td>12</td>
<td>8-14-17-27</td>
<td>31</td>
<td>29.2</td>
<td>CL</td>
<td></td>
<td>Orange and gray, wet, hard, Lean CLAY with sand</td>
<td></td>
</tr>
<tr>
<td>S-3</td>
<td>6.0</td>
<td>6</td>
<td>5-10-14-10</td>
<td>24</td>
<td>27.2</td>
<td>SM</td>
<td></td>
<td>Brown and orange, wet, medium dense, Silty SAND with rock fragments</td>
<td></td>
</tr>
<tr>
<td>S-4</td>
<td>8.0</td>
<td>12</td>
<td>5-12-10-8</td>
<td>22</td>
<td>21.2</td>
<td>SM</td>
<td></td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>S-5</td>
<td>10.0</td>
<td>13</td>
<td>7-10-14-17</td>
<td>24</td>
<td>15.0</td>
<td>SM</td>
<td></td>
<td>Same</td>
<td>Boring terminated at 12.0 feet.</td>
</tr>
</tbody>
</table>

**GEO-TECHNOLOGY ASSOCIATES, INC.**

18 Boulder Circle, Suite 36  
New Castle, DE 19720

**NOTES:** Elevation and location should be considered approximate.

**LOG OF BORING NO. B-2B**
**LOG OF BORING NO. B-3**

**PROJECT:** Brandywine Zoo  
**PROJECT NO.:** 181154  
**PROJECT LOCATION:** Wilmington, Delaware

**DATE STARTED:** 12/6/18  
**DATE COMPLETED:** 12/6/18  
**DATE:** 12/6/18  
**WATER LEVEL (ft):** Dry

**GROUND SURFACE ELEVATION:** 38.5  
**WATER ENCOUNTERED DURING DRILLING (ft):** Dry  
**CAVED (ft):** 3.7  
**BOC:**

**GROUND SURFACE ELEVATION:**

<table>
<thead>
<tr>
<th>SAMPLE NUMBER</th>
<th>SAMPLE DEPTH (ft)</th>
<th>SAMPLE RECOVERY (in.)</th>
<th>BLOWS/S/6 inches</th>
<th>N (blows/ft.)</th>
<th>ELEVATION (ft.)</th>
<th>USCS</th>
<th>GRAPHIC SYMBOL</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>0.0</td>
<td>14</td>
<td>8-10-12-17</td>
<td>22</td>
<td>38.5</td>
<td>SM</td>
<td>Orange, brown, and black, moist, medium dense, Silty SAND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-2</td>
<td>2.0</td>
<td>16</td>
<td>18-24-25-50/4&quot;</td>
<td>49</td>
<td>34.5</td>
<td></td>
<td>Gray-brown, moist dense, Silty SAND with rock fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DRILLING CONTRACTOR:** GTA  
**DRILLER:** D. Hans, Jr.  
**DRILLING METHOD:** Tripod  
**EQUIPMENT:** Diedrich D50  
**LOGGED BY:** K. Kershaw  
**CHECKED BY:** C. Reith

**NOTES:** Elevation and location should be considered approximate.
**LOG OF TEST PIT NO. TP-1**

**PROJECT:** Brandywine Zoo  
**PROJECT LOCATION:** Wilmington, Delaware  
**CLIENT:** GWWO, Inc./Architects  

**DATE STARTED:** 12/10/18  
**DATE COMPLETED:** 12/10/18  
**CONTRACTOR:** R. Keating and Sons  
**EQUIPMENT:** Kubota Mini Excavator

---

**GROUNDWATER ENCOUNTERED:** 8.0  
**GROUND SURFACE ELEVATION:** 77  
**DATUM:** Topo  
**LOGGED BY:** C. Reith  
**CHECKED BY:** C. Reith

<table>
<thead>
<tr>
<th>ELEVATION (ft.)</th>
<th>DEPTH (ft.)</th>
<th>USCS</th>
<th>GRAPHIC SYMBOL</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>76.1</td>
<td>TS</td>
<td></td>
<td>10 inches +/- topsoil/forest litter</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>69.0</td>
<td>ML</td>
<td></td>
<td>Orange-brown, moist, SILT with sand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>69.5</td>
<td></td>
<td></td>
<td>same, contains gravel and cobble size rock fragments</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>69.0</td>
<td>HW</td>
<td>Highly Weathered Rock</td>
<td>Test pit terminated at 8.0 feet</td>
<td>difficult excavation at 5 feet</td>
</tr>
<tr>
<td>8</td>
<td>69.5</td>
<td></td>
<td></td>
<td>water running in at 8 feet</td>
<td></td>
</tr>
</tbody>
</table>
**LOG OF TEST PIT NO. TP-2**

**PROJECT:** Brandywine Zoo  
**PROJECT LOCATION:** Wilmington, Delaware  
**CLIENT:** GWWO, Inc./Architects  
**PROJECT NO.:** 181154  
**GROUNDWATER ENCOUNTERED:** N/E  
**GROUND SURFACE ELEVATION:** 66  
**DATE STARTED:** 12/10/18  
**DATE COMPLETED:** 12/10/18  
**CONTRACTOR:** R. Keating and Sons  
**EQUIPMENT:** Kubota Mini Excavator  
**DATUM:** Topo  
**LOGGED BY:** C. Reith  
**CHECKED BY:** C. Reith

<table>
<thead>
<tr>
<th>ELEVATION (ft)</th>
<th>DEPTH (ft)</th>
<th>USCS</th>
<th>GRAPHIC SYMBOL</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>TS</td>
<td></td>
<td>18 inches +/- topsoil, root mat, and forest litter</td>
<td></td>
</tr>
<tr>
<td>64.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63.5</td>
<td>1</td>
<td>ML</td>
<td></td>
<td>Tan and orange-brown, moist, SILT with sand</td>
<td></td>
</tr>
<tr>
<td>62.0</td>
<td>2</td>
<td></td>
<td></td>
<td>same, orange and gray mottles</td>
<td>water seepage from sidewalls of excavation at 3.0 feet</td>
</tr>
<tr>
<td>58.5</td>
<td>3</td>
<td></td>
<td></td>
<td>same, contains gravel and cobble size rock fragments</td>
<td></td>
</tr>
<tr>
<td>57.5</td>
<td>4</td>
<td>HW</td>
<td></td>
<td>Highly Weathered Rock</td>
<td>difficult excavation at 7.0 feet</td>
</tr>
<tr>
<td>18</td>
<td>9</td>
<td></td>
<td></td>
<td>Test pit terminated at 8.5 feet</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

GEO-TECHNOLOGY ASSOCIATES, INC.  
18 Boulden Circle, Suite 36  
New Castle, DE 19720
**LOG OF TEST PIT NO. TP-3**

<table>
<thead>
<tr>
<th>ELEVATION (ft.)</th>
<th>GRAPHIC SYMBOL</th>
<th>USCS</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>TS</td>
<td></td>
<td>18 inches +/- topsoil, root mat, and forest litter</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>ML</td>
<td></td>
<td>Tan and orange-brown, moist, Silt with sand</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CL</td>
<td></td>
<td>Orange-brown, moist to wet, Sandy Lean CLAY, contains gravel and cobble size rock fragments</td>
<td>difficult excavation at 4.5 feet</td>
</tr>
<tr>
<td>5.0</td>
<td>HW</td>
<td>62.5</td>
<td>Highly Weathered Rock</td>
<td>Test pit terminated at 5.0 feet</td>
</tr>
</tbody>
</table>
### LOG OF TEST PIT NO. TP-4

**PROJECT:** Brandywine Zoo  
**PROJECT LOCATION:** Wilmington, Delaware  
**CLIENT:** GWWO, Inc./Architects  
**DATE STARTED:** 12/10/18  
**DATE COMPLETED:** 12/10/18  
**CONTRACTOR:** R. Keating and Sons  
**EQUIPMENT:** Kubota Mini Excavator

<table>
<thead>
<tr>
<th>ELEVATION (ft.)</th>
<th>USCS</th>
<th>GRAPHIC SYMBOL</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>TS</td>
<td></td>
<td>12 inches +/- topsoil/forest litter</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ML</td>
<td></td>
<td>Tan, orange, and brown, moist, SILT with sand</td>
<td>same, Orange-brown</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>same, contains gravel and cobble size rock fragments</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>HW</td>
<td></td>
<td>Highly Weathered Rock</td>
<td>Test pit terminated at 8.0 feet</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDWATER ENCOUNTERED:** N/E  
**GROUND SURFACE ELEVATION:** 60  
**DATUM:** Topo  
**LOGGED BY:** C. Reith  
**CHECKED BY:** C. Reith

**NOTES:**

---

**GEO-TECHNOLOGY ASSOCIATES, INC.**
18 Boulden Circle, Suite 36  
New Castle, DE 19720
Particle Size Distribution Report

**Soil Description**

Dark Brown, white and orange, Silty SAND

**Atterberg Limits**

- **PL** = 27
- **LL** = 43
- **Plastic Limit** = 16
- **NM** = 33.1

**Coefficients**

- **D_{90}** = 4.0154
- **D_{50}** = 2.9817
- **D_{60}** = 0.4562
- **D_{10}** = 0.0880
- **D_{15}** = 0.0880
- **C_u** = 0.0880
- **C_c** = 0.0880

**Classification**

- **USCS** = SM
- **AASHTO** = A-2-7(1)

**Remarks**

- (no specification provided)

Source of Sample: B-1

Sample Number: S-3

Date: 12/7/2018

Client: GWWO, Inc./Architects

Project: Brandywine Zoo

Project No: 181154

Not For Bidding

GEO-TECHNOLOGY ASSOCIATES, INC.

18 Boulden Circle, Suite 36
New Castle, DE 19720

Tested By: K. Kershaw
Checked By: C. Reith
SECTION 02 41 00 - SELECTIVE DEMOLITION

PART 1  GENERAL

1.1  SECTION INCLUDES

A.  Selective demolition of built site elements.
B.  Selective demolition of building elements for alteration purposes.
C.  Salvage of existing items to be reused or recycled.

1.2  DEFINITIONS

A.  Existing to Remain:  Existing items that are not to be removed or dismantled, except to
    the degree indicated for performing required Work.
B.  Remove:  To detach items from existing construction and dispose of them off-site
    unless indicated to be salvaged or reinstalled.
C.  Remove and Reinstall:  To detach items from existing construction in a manner to
    prevent damage, to prepare for reuse, and to reinstall where indicated.
D.  Retain:  To keep and protect from damage existing items that are not to be removed or
    dismantled.
E.  Salvage:  To protect removed or dismantled items from damage and to deliver them to
    Owner ready for reuse.

1.3  REFERENCE STANDARDS

A.  29 CFR 1926 - U.S. Occupational Safety and Health Standards.
B.  NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition
    Operations.

1.4  MATERIALS OWNERSHIP

A.  Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5  SUBMITTALS

A.  Site Plan:  Showing:
    1.  Vegetation to be protected.
    2.  Areas for temporary construction and field offices.
    3.  Areas for temporary and permanent placement of removed materials.
B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by Contractor's removal and dismantling operations.

C. List of Items Indicated to Be Salvaged: Prepare a list of items indicated on Drawings to be salvaged for Owner's use or for reinstallation. Submit 15 days before preconstruction conference.

D. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and noise control, and for environmental protection. Indicate proposed locations and construction of barriers.

E. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.

F. Project Record Documents:
   1. Record Drawings: Accurately record actual locations of capped and active utilities and subsurface construction.
   2. Inventory: Submit a list of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.

B. Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning removal and dismantling work. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 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.

C. Notify Architect and Owner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:
   1. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.
   2. Hazardous materials will be removed by Owner.
E. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
   1. Provide not less than 72 hours’ notice of activities that will affect operations of adjacent occupied buildings.
   2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
      a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

F. Storage or sale of removed items or materials on-site is not permitted.

G. 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.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.1 SCOPE
   A. Remove the entire building designated ‘Shed’ as indicated on drawings.
   B. Remove paving and curbs as indicated on drawings.
   C. Within area of new construction, remove foundation walls and footings to a minimum of 2 feet below finished grade.
   D. Remove concrete slabs on grade as indicated on drawings.
   E. Remove fences and gates as indicated on drawings.
   F. Remove other items indicated, for salvage, relocation, and recycling.
   G. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 22 00.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS
   A. Comply with other requirements specified in Section 01 70 00.
   B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
      1. Obtain required permits.
      2. Comply with applicable requirements of NFPA 241.
3. Use of explosives is not permitted.
4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
5. Provide, erect, and maintain temporary barriers and security devices.
6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
8. Do not close or obstruct roadways or sidewalks without permit.
9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

C. Do not begin removal until receipt of notification to proceed from Owner.
D. Do not begin removal until built elements to be salvaged or relocated have been removed.

E. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

H. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

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

J. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.
3.3 EXISTING UTILITIES

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

B. Protect existing utilities to remain from damage.

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

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

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

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

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

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

3.4 SELECTIVE DEMOLITION, GENERAL

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

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

C. Selective Demolition Procedures: 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. 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.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

D. 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 designated by Owner.
   5. Protect items from damage during transport and storage.

E. 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.

F. 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 reinstalled in their original locations after selective demolition operations are complete.

G. Protection:
   1. Temporary Shoring:
      a. Prevent movement of structure; provide shoring and bracing if necessary.
      b. 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.
   2. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
      a. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
      b. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
c. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
d. Cover and protect furniture, furnishings, and equipment that have not been removed.
e. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 - Temporary Facilities and Controls
3. Remove temporary barricades and protections where hazards no longer exist.

H. Cutting and Patching:
1. Perform cutting to accomplish removals neatly and as specified for cutting new work.
2. Repair adjacent construction and finishes damaged during removal work.
3. Patch as specified for patching new work.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS
A. Asphalt: Demolish in sections. Cut full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove between saw cuts.
B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 SITE RESTORATION
A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 31.
B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.7 REPAIRS
A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.8 DEBRIS AND WASTE REMOVAL
A. Remove debris, junk, and trash from site.
B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
C. Leave site in clean condition, ready for subsequent work.
D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 41 00
SELECTIVE DEMOLITION

02 41 00 - 8
SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.

B. Related Sections:
   1. Division 07 Section “Self-Adhering Sheet Waterproofing for concrete finish requirements.
   2. Division 07 Section “Cold Fluid Applied Waterproofing” for concrete finish requirements.
   3. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup
spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
   1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

F. Samples: For waterstops and vapor retarder.

G. Welding certificates.

H. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Fiber reinforcement.
   6. Waterstops.
   7. Curing compounds.
   8. Floor and slab treatments.
  10. Adhesives.
  11. Vapor retarders.
  12. Semirigid joint filler.

I. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates.

J. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

K. Field quality-control reports.

L. Minutes of preinstallation conference.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade I, according to ACI CA-1 or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: Build mockups to verify texture of broom finish concrete for garage floor surfaces is acceptable.
   1. Build mockup of a 4 inch thick concrete slab at least 4 feet by 4 feet square.
   2. After texture is approved, the specified sealer shall be applied for review by the Architect and Owner.

I. Preinstallation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.
   e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold, and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. High-density overlay, Class 1 or better.
      b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
      c. Structural 1, B-B or better; mill oiled and edge sealed.
      d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.


E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, Type I, gray or white. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class 3S, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


2.5 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Set-Acceleration Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM 494/C 494M, Type C.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. BASF Construction Chemicals – Building Systems; Rheocrete CNI.
      b. Euclid Chemical Company (The), an RPM company; [ARRMATECT]
      c. Grace Construction Products W.R. Grace & Co.; DCI
      d. Sika Corporation; Sika CNI

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of
forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Construction Chemicals – Building Systems; Rheocrete 222+
   b. Grace Construction Products, W.R. Grace & Co.; DCI-S.
   c. Sika Corporation; FerroGard 901.

E. **Color Pigment:** ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

   1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      a. Davis Colors.
      c. Solomon Colors, Inc.

2. **Location:** As selected by Architect from manufacturer's full range.

2.6 **VAPOR RETARDERS**

A. **Plastic Vapor Retarder:** ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape. Minimum 15 mils nominal thickness.

   1. **Products:** Subject to compliance with requirements, provide one of the following:
      a. Raven Industries Inc.; Vapor Block 15.
      b. Stego Industries, LLC; Stego Wrap, 15 mils.

2.7 **CURING MATERIALS**

A. **Evaporation Retarder:** Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

   1. **Products:** Subject to compliance with requirements, provide one of the following:
      a. Conspec by Dayton Superior; Aquafilm.
      b. Dayton Superior Corporation; Sure Film (J-74).
      c. Euclid Chemical Company (The), an RPM company; Eucobar.
      d. L&M Construction Chemicals, Inc.; E-CON.
      e. Meadows, W. R., Inc.; EVAPRE.
      f. Sika Corporation; SikaFilm.

B. **Absorptive Cover:** AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. **Moisture-Retaining Cover:** ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B, 18 to 25 percent solids, nondissipating.
   1. Products:
      a. Dayton Superior Corporation; Safe Cure and Seal (J-19).
      b. Euclid Chemical Company (The); Diamond Clear VOX.
      c. L&M Construction Chemicals, Inc.; Dress & Seal WB.
      e. Sonneborn, Div. of ChemRex; Kure-N-Seal.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A.
   1. Products:
      a. Euclid Chemical Company (The); Super Diamond Clear VOX.
      b. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.

2.8 RELATED MATERIALS


B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Corrosion Protective Coating: Treat concrete surfaces to protect from deicing salts, as follows to protect against absorption of chloride-ions.
      a. Sealing Slab Surfaces:
         1) Materials: Sikagard 701W, by Sika Corporation or Euco-Guard VOX; Euclid Chemical Company.
         2) Apply 2 coats of sealing compound to parking garage floor slab
      b. Vertical Surfaces:
1) Materials: Sikagard 62 Epoxy by Sika Corporation or equivalent by Euclid Chemical Company.
2) Apply coating to columns starting at the footer and extending a minimum of 18 above the top of finished slab.
3) Locations: Seal Column Bases and other Vertical Surfaces noted on the Drawings.

2. All Exterior Concrete: Provide Sikagard 701W, by Sikla Corporation or Euco-Guard VOX by Euclid Chemicals.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: No less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.
   4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
   5. Silica Fume: 10 percent.
   6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
   7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As Indicated.
   2. Maximum Water-Cementitious Materials Ratio: 0.50.
   3. Slump Limit: 4 to 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

B. Foundation & Retaining Walls: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As Indicated.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 4 to 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As Indicated.
   3. Slump Limit: 4 inches, plus or minus 1 inch.
   4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As Indicated.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.
F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
   3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete pour.
2. Vapor Barrier shall extend down foundation wall to top of footing.
3. Lap vapor barrier down face of footing wall to top of concrete footing. Seal vapor barrier to footing with manufacturer’s mastic.
4. Overlap joints 6 inches and seal with manufacturer’s tape.
5. Seal all penetrations (including pipes) per manufacturer’s instructions with manufacturer’s Tape and Mastic.
6. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
7. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.
8. Vapor Barrier installation shall be observed by the Owner’s rep prior to placement of the concrete.
9. Seal the different types of vapor retarders together by over lapping 6 inches and taping the intersection of the two vapor barriers.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   6. Where indicated, use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Shrinkage Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints (Exposed Joints): Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer’s written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practical.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:
   1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor’s option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view,
C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete surfaces exposed to public view:
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
      a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15, for slabs-on-grade.
      b. Specified overall value of flatness, F(F) 30; with minimum local value of flatness, F(F) 24; for suspended slabs.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickeet or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
E. Broom Finish: Apply a broom finish to exposed garage floors, exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
   1. Immediately after float finishing, roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

F. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer’s written instructions and as follows:
   1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
   2. After broadcasting and tamping, apply float finish.
   3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill with 3/8” maximum aggregate for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions
after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
   a. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer, unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

F. Corrosion Protective Coating:
1. Horizontal Surfaces: Apply two coats of sealer to all exterior concrete, parking garage floor slab
2. Vertical Surfaces: Apply one coat of sealer to concrete columns of parking garage and other vertical surfaces indicated on the Drawings.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 PAVEMENT MARKINGS AND WHEEL STOPS

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 90 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils

E. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply
bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.

B. Inspections:
1. Steel reinforcement size, spacing, placement, support, cover and laps.
2. Dowel size, spacing, placement, support and embedment.
3. Bolts, studs, and other embedments, and size, location and embedment depth.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.
8. Inspection reports shall be submitted to the Owner, Architect, Engineer and Contractor within 48 hours of inspection.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION
SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Concrete building brick.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.

B. Related Sections:

1. Division 05 Section "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
3. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Restoring of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Clay Masonry Unit Test: For each type of unit required, according to ASTM C 67 for compressive strength.
2. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
4. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
6. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.7 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
   a. Include data on material properties and material test reports substantiating compliance with requirements.
   b. For masonry unit, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
7. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

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 4’ x 10’ mockups of architectural wall types: B.11, B.21, B.23, & C.01 to capture a coping, wood cladding, flashing, stone cap, and veneer plus the back-up wall composition.
   a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
   b. Include fluid applied air vapor barrier system with all flashings and seals.
   c. Include sample window opening framed and flashed in wall mockup.
   d. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
   e. Include concrete masonry and metal stud framing backup, gypsum sheathing, continuous insulation system, flashing, cavity drainage material, and weep vents in exterior masonry-veneer wall mockup.
   f. Provide quantity of mockup panels as required for all exterior finish materials including face brick, EIFS and siding.

2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1.9 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.


PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

2. Provide bullnose units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2400 psi. 

2. Density Classification: Normal weight.

3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

C. Concrete Building Brick: ASTM C 55.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of (see drawings).
2. Density Classification: Normal weight.

2.3 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Division 03 Section "Cast in Place Concrete," and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

E. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

F. Aggregate for Grout: ASTM C 404.
G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
   
   1. Products: Subject to compliance with requirements, provide one of the following:
      
      a. Euclid Chemical Company (The); Accelguard 80.
      c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

H. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

   1. Interior Walls: Hot-dip galvanized, carbon steel.
   2. Exterior Walls: Hot-dip galvanized, carbon steel.
   5. Wire Size for Veneer Ties: 0.187-inch diameter.
   6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Truss type with single pair of side rods.

D. Masonry-Joint Reinforcement for Multiwythe Masonry:

   1. Adjustable (two-piece) type, truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch (1.5 mm) and maximum vertical adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

2. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.7 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

B. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors as indicated

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing at column caps and coping stones: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
2. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick
3. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Thru-Wall Flashing in brick veneer walls: For flashing not exposed to the exterior, stainless steel core type:

1. Products:
   a. York Manufacturing, Inc.; Multi-Flash SS.
2. Characteristics:
   a. Stainless Steel Type: 304, ASTM A167.


4. End Dams; Outside and Inside Corners: Provide manufacturer’s pre-fabricated corners and end dams of 26 gage stainless steel. Field fabricated corners are not acceptable.

5. Adhesive: Non-asphalt for laminating adhesive.


7. Mastic or sealant: Manufacturer's standard for specified flashing.

8. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

9. Termination Bar: Manufacturer's standard 1" wide, minimum by 1/8" thickness, minimum by continuous length pre-punched stainless steel bar complete with stainless steel fasteners.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.

2. Where flashing is fully concealed, use flexible flashing with metal drip edge.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth
1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Products: Subject to compliance with requirements, provide one of the following:
   1) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
   2) Heckmann Building Products Inc.; No. 85 Cell Vent.
   3) Hohmann & Barnard, Inc.; Quadro-Vent.
   4) Wire-Bond; Cell Vent.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide the following:
   a. Mortar Net USA, Ltd.; Mortar Net (no substitutions).

2. Provide one of the following configurations:
   a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
   c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
   d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

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

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond and special bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.

2. Allow cleaned surfaces to dry before setting.

3. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 CAVITY WALLS

A. Bond wythes of cavity wall together as follows:


   a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.

   b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.

   c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement to allow for differential movement regardless of whether bed joints align.

2. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not more than 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
3.7 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.9 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally with not less than 1 anchor for each 1.77 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:
   1. Install preformed control-joint gaskets designed to fit standard sash block.

C. Form expansion joints in brick as follows:
   1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where
indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 6 inches above the cavity drainage material; with upper edge anchored to the backup wall with a stainless steel termination bar. The flashing termination shall be sealed to the air and vapor barrier system with transition tape used for spray applied air and vapor barrier.

3. At lintels and shelf angles, extend flashing a minimum of 6 inches above the cavity drainage material into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.

4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop thru-wall flashing 1/2 inch back from outside face of wall and adhere thru-wall flashing to top of metal drip edge.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.

2. Space weep holes 16 inches o.c. unless otherwise indicated.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

F. Install vents in head joints in exterior wythes at 16 inches o.c.. Use specified weep/vent products to form vents.

3.13 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
J. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.15 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisel.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
8. Clean stone trim to comply with stone supplier's written instructions.

3.16 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess clean masonry waste and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00
SECTION 04 43 13 - STONE MASONRY VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cut stone veneer at exterior walls.
B. Metal anchors and accessories.
C. Setting mortar.
D. Accessories

1.2 REFERENCE STANDARDS

B. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.3 SUBMITTALS

A. Product Data: Provide data on stone units, mortar, and reinforcement.
B. Samples: Submit four stone samples illustrating minimum and maximum stone sizes, color range, texture, and markings.

C. Samples: Submit mortar color samples.

1.4 QUALITY ASSURANCE

A. Stone Fabricator Qualifications: Company specializing in fabricating cut stone with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type required by this section, with minimum ten years of documented experience.

1.5 MOCK-UP

A. Construct stone wall mock-up, 4 feet long by 4 feet wide; include stone anchor accessories, corner condition, and typical control joint in mock-up.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect stone from discoloration during storage on site.

B. Provide ventilation to prevent condensation from forming on stone.

1.7 FIELD CONDITIONS

A. Cold Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Stone Quarriers:
   4. Or Approved Equal.

B. Stone Masonry Reinforcement and Accessories
   3. Or Approved Equal.
2.2 STONE

A. Surface Texture: Split face.

B. Color: To Match Lemur Lookout Exhibit, based on existing stone on restroom building next to wildlife theater.

2.3 ADHESIVE MATERIALS

A. Manufacturers:
   1. LATICRETE International, Inc; LATICRETE MVIS Hi-2ond Mortar.
   3. Parex USA Inc; Thin Veneer Adhesive.

B. Thin-Set Mortar: ANSI A118.4, polymer-modified, freeze-thaw stable.

2.4 MORTAR

A. Setting Mortar: ASTM C270, Type S, using the Proportion Method.
   1. Products:
      d. Or approved equal.

2.5 MORTAR MIXES

   1. Masonry below grade and in contact with earth: Type S.
   2. Exterior, non-loadbearing masonry: Type N.

2.6 LATH

   1. Weight: 2.5 lb./sq. yd, minimum.

B. Ribbed Metal Lath: ASTM C847, galvanized; 1/2 inch thick.

C. Welded Wire Lath: ASTM C933; galvanized; with 2 inch square openings, and of weight to suit application, and as specified in ASTM C841 for framing spacing.

D. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; same finish as lath.
2.7 ACCESSORIES

A. Horizontal Joint Reinforcement: Truss type; stainless steel wire conforming to ASTM A580/A580M Type 304, 3/16 inch diameter side rods with 0.1483 inch diameter cross ties.

B. Other Anchors in Direct Contact with Stone: ASTM A666, Type 304, stainless steel, of sizes and configurations required for support of stone and applicable superimposed loads.

C. Flashings:
   1. Stainless Steel: ASTM A666, Type 304, soft temper; 26 gage, 0.0187 inch thick; finish 2B to 2D.

D. Weep/Cavity Vents: Polyethylene tubing.

E. Back Coating:
   1. Cementitious parging of mortar to a minimum thickness of 1/2 inch

F. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.

2.8 STONE FABRICATION

A. Nominal Thickness: 2 inch

B. Pattern and Coursing: Match Lemur Lookout Exhibit pattern and coarsing, based on restroom building pattern and coursing.

C. Fabricate for 3/8 inch beds and joints.

D. Bed and Joint Surfaces:
   1. Cut or sawn full square for full thickness of unit.

E. Backs: Sawn.

F. Form stone corners to irregular joint profile. Clean jagged corners from stone in preparation for setting.

G. Slope exposed top surfaces of stone and horizontal sill surfaces for shedding water.

H. Cut drip slot in bottom surface of work projecting more than 1/2 inch over window frame. Size slot not less than 3/8 inch wide and 1/4 inch deep for full width of projection.
PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that support work and site conditions are ready to receive work of this section.

B. Verify that items built-in under other sections are properly located and sized.

3.2 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive stone veneer.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for installation of stone veneer.

3.3 PREPARATION

A. Establish lines, levels, and coursing. Protect from disturbance.

B. Clean stone prior to erection. Do not use wire brushes or implements that mark or damage exposed surfaces.

C. Clean sawn surfaces of rust stains and iron particles.

D. Coat back surfaces not to be in contact with setting mortar with back coating material. Allow coating to cure.

3.4 INSTALLATION

A. Install flashings of longest practical length and seal watertight to back-up. Lap end joints minimum 6 inches and seal watertight.

B. Cut stone at site to produce clean faces.

C. Size stone units to fit opening dimensions and perimeter conditions.

D. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.

E. Arrange stone pattern to provide color uniformity and minimize visual variations, and provide a uniform blend of stone unit sizes.

F. Arrange stone coursing in mosaic pattern with consistent joint width.

G. Set stone in full mortar setting bed to fully support stone over bearing surface. Use setting buttons or shims to maintain correct joint width.
H. Install weep/cavity vents in vertical stone joints at 24 inches on center horizontally; immediately above horizontal flashings, above shelf angles and supports, and at top of each cavity space; do not permit mortar accumulation in cavity space.

I. Exterior Applications: Comply with TCNA (HB) Method W201, W202, or W244E.

J. Install lath and furring for Portland cement plaster in accordance with ASTM C1063.

K. Lath Installation:
   1. Apply metal lath taut, with long dimension perpendicular to supports.
   2. Lap ends minimum 1 inch. Secure end laps with tie wire where they occur between supports.
   3. Lap sides of diamond mesh lath minimum 1-1/2 inches.
   4. Nest outside ribs of rib lath together.
   5. Attach metal lath to concrete using wire hair pins. Attach anchors to backup surface; space at maximum 24 inches on center.
   6. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
   7. Place corner bead at external wall corners; fasten at outer edges of lath only.
   8. Place 4 inch wide strips of metal lath centered over junctions of dissimilar backing materials. Secure rigidly in place.
   9. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

3.5 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

3.6 PLACING AND BONDING

A. Remove excess mortar as work progresses.

B. Interlock intersections and external corners, except for units laid in stack bond.

C. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.7 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions at least 6 inches, minimum, to form watertight pan.
B. Extend metal flashings through exterior face of masonry and turn down to form drip.

C. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.8 CONTROL AND EXPANSION JOINTS

A. Form joints as detailed on drawings.

3.9 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

3.10 CUTTING AND FITTING

A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

3.11 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

3.12 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

3.13 INSTALLATION - MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

END OF SECTION 04 43 13
STONE MASONRY VENEER
SECTION 04 72 00 - CAST STONE MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Architectural cast stone.

B. Units required are:
   1. Exterior wall units, including sills and water tables.

1.2 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.


C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

D. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.


F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.


1.3 SUBMITTALS

A. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.

B. Verification Samples: Pieces of actual cast stone components not less than 6 inches square, illustrating range of color and texture to be anticipated in components furnished for the project.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.

B. Number each piece individually to match shop drawings and schedule.

C. Store cast stone components and installation materials in accordance with manufacturer's instructions.

D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.

E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.

F. Store mortar materials where contamination can be avoided.

G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Architectural Cast Stone:
   1. Any current producer member of the Architectural Precast Association.
   2. Any current producer member of the Cast Stone Institute.
   3. Or Approved Equal.
2.2 ARCHITECTURAL CAST STONE

   1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
   2. Freeze-Thaw Resistance: Demonstrated by field experience.
   3. Surface Texture: Fine grained texture, with no bug holes, air voids, or other surface blemishes visible from distance of 20 feet.
   5. Remove cement film from exposed surfaces before packaging for shipment.

B. Shapes: Provide shapes indicated on drawings.
   1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch or length divided by 360, whichever is greater, but not more than 1/4 inch.
   2. Unless otherwise indicated on drawings, provide:
      a. Wash or slope of 1:12 on exterior horizontal surfaces.
      b. Drips on projecting components, wherever possible.
      c. Raised fillets at back of sills and at ends to be built in.

C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.
   1. Pieces More than 24 inches in Any Dimension: Provide full length two-way reinforcement of cross-sectional area not less than 0.25 percent of unit cross-sectional area.

2.3 MATERIALS

A. Portland Cement: ASTM C150/C150M.
   1. For Mortar: Type I or II, except Type III may be used in cold weather.

B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.

C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.

D. Admixtures: ASTM C494/C494M.

E. Water: Potable.

F. Reinforcing Bars: ASTM A615/A615M deformed bars, galvanized.
   1. Galvanized in accordance with ASTM A767/A767M, Class I.

H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.

I. Shelf Angles and Similar Structural Items: Hot-dip galvanized steel per ASTM A123/A123M, of shapes and sizes as required for conditions.

J. Mortar: Portland cement-lime, as specified in Section 04 05 11; do not use masonry cement.

K. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.4 SOURCE QUALITY CONTROL

A. Test compressive strength and absorption of specimens selected at random from plant production.
   1. Test in accordance with ASTM C642.
   2. Select specimens at rate of 3 per 500 cubic feet, with a minimum of 3 per production week.

PART 3  EXECUTION

3.1 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.

B. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 20 00.

B. Mechanically anchor cast stone units indicated; set remainder in mortar.

C. Setting:
   1. Drench cast stone components with clear, running water immediately before installation.
   2. Set units in a full bed of mortar unless otherwise indicated.
   3. Fill vertical joints with mortar.
   4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
3.3 TOLERANCES

A. Joints: Make all joints 3/8 inch, except as otherwise detailed.
   1. Rake mortar joints 3/4 inch for pointing.
   2. Remove excess mortar from face of stone before pointing joints.
   3. Point joints with mortar in layers 3/8 inch thick and tool to a slight concave profile.
   4. Leave the following joints open for sealant:
      a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
      b. Joints in projecting units.
      c. Joints between rigidly anchored units, including soffits, panels, and column covers.
      d. Joints below lugged sills and stair treads.
      e. Joints below ledge and relieving angles.
      f. Joints labeled "expansion joint".

B. Installation Tolerances:
   1. Variation from Plumb: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet or more.
   2. Variation from Level: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet, or 3/8 inch maximum.
   3. Variation in Joint Width: Not more than 1/8 inch in 36 inches or 1/4 of nominal joint width, whichever is less.
   4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.4 REPAIR

A. Repairs: Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet.
   1. Repair with matching touchup material provided by the manufacturer and in accordance with manufacturer's instructions.
   2. Repair methods and results subject to Architect's approval.

3.5 CLEANING

A. Keep cast stone components clean as work progresses.

B. Clean completed exposed cast stone after mortar is thoroughly set and cured.
   1. Wet surfaces with water before applying cleaner.
   2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
   3. Remove cleaner promptly by rinsing thoroughly with clear water.
   4. Do not use acidic cleaners.
3.6 PROTECTION

A. Protect completed work from damage.

B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION 04 72 00
SECTION 05 05 00 POST-INSTALLED ANCHORAGE

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 post-installed anchor, reinforcing bar dowels, and the type of work using anchors drilled into concrete and/or masonry.

B. Related Sections: include the following:

1. Division 03 Section “Cast-In-Place Concrete” for installing anchor bolts, steel pipe sleeves, and other items cast into concrete.
2. Division 05 Section “Structural Steel Framing.”

1.3 SUBMITTALS

A. Product Data: Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.

1. Manufacturer’s installation instructions for each type of anchor.

B. Material Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

C. Material Certificates:

1. ICC ES Evaluation Reports.

D. Qualification Data & Procedures: Submit installer qualifications for project personnel and supervisor. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
1. Drilled-in anchors shall be installed by an installer with at least five years of experience performing similar installations.

B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer’s representative for the installer on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:

2. hole drilling procedure
3. hole preparation & cleaning technique
4. adhesive injection technique & dispenser training / maintenance
5. rebar dowel preparation and installation
6. proof loading/torquing

C. Certifications: Unless otherwise authorized by the Engineer, anchors shall have one of the following certifications:


1.5 DELIVERY, STORAGE AND HANDLING

A. Store anchors in accordance with manufacturer’s recommendations to prevent damage and corrosion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fasteners and Anchors:

1. Bolts and Studs: ASTM A307; ASTM A449 where “high strength” is indicated on the Drawings.
4. Carbon Steel Threaded Rod: ASTM A36; or ASTM A193 Grade B7; or ISO 898 Class 5.8.
10. Reinforcing Dowels: ASTM A615

2.2 DRILLED-IN ANCHORS

POST-INSTALLED ANCHORAGE
A. **Wedge Anchors:** Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings conforming to ICC ES AC01 or ICC ES AC193. Type and size as indicated on Drawings.

1. **Interior Use:** Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
2. **Exterior Use:** As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 or Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
3. **Products:** Subject to compliance with requirements, provide one of the following products specified.
   b. Hilti Kwik Bolt TZ, ICC ESR-1917 (carbon steel and AISI Type 304 Stainless Steel), Hilti.
   c. Power-Stud, Powers Fasteners Inc.

B. **Cartridge Injection Adhesive Anchors:** Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer’s installation instructions. Type and size as indicated on Drawings.

1. **Interior Use:** Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
2. **Exterior Use:** As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
3. **Reinforcing dowels shall be A615 Grade 60.**
4. **Products:** Subject to compliance with requirements, provide one of the following:
   a. Hilti HAS threaded rods or HIT-TZ rods with HIT HY-200 Adhesive Anchorage System for anchorage to concrete, ICC ER-5193, ICC ESR-1562 or HIT HY-70 Hybrid for anchorage to masonry.
   b. Hilti HAS threaded rods with RE 500 Injection Adhesive Anchoring System for anchorage to concrete, ICC ESR-1682.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Drilled-In Anchors: Use templates to locate anchors accurately.

1. Drill holes with rotary impact hammer drills using carbide-tipped bits and core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
   a. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. HIT HY-200 and HIT ICE shall not be installed in core drilled holes.
   b. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
   c. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

2. Perform anchor installation in accordance with manufacturer instructions.

3. Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer’s recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

4. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Holes do not need to be cleaned for HIT-TZ Rods with HY-200 in accordance with ICC ESR-1562. Holes may be dry, damp or wet. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface.
Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

5. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.2 REPAIR OF DEFECTIVE WORK

A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

3.3 FIELD QUALITY CONTROL

A. Testing and Inspection: Owner will engage a special inspection and qualified testing and inspection agency to perform field tests and prepare test reports.

B. Visual Inspections: Minimum anchor embedments, size and spacings

END OF SECTION
Brandywine Zoo
QUARANTINE SUPPORT BUILDING
100% CD DFM Submission
Division of Parks and Recreation Project No. WBZ-9

June 2, 2020

THIS SHEET INTENTIONALLY LEFT BLANK

POST-INSTALLED ANCHORAGE
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. Grout.

B. Related Sections:
   1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
   2. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.
   3. Division 05 Section "Metal Stairs."

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, to withstand loads indicated and comply with other information and restrictions indicated.
   1. Select and complete connections using schematic details indicated and AISC 360.
   2. Use ASD; data are given at service-load level.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.
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.
   5. Identify demand critical welds.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Tension-control, high-strength bolt-nut-washer assemblies.
   4. Shear stud connectors.
   5. Shop primers.

F. Source quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   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. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

B. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 572/A 572M, Grade 50.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

1. Weight Class: Standard.
2. Finish: Black.
2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type I, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type I, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

D. Unheaded Anchor Rods: ASTM A 36/A 36M.

4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain.

E. Threaded Rods: ASTM A 36/A 36M.

3. Finish: Plain.

2.3 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanizing Repair Paint: ASTM A 780.
2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, 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 according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

   1. Camber structural-steel members when indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize exterior dunnage for roof top equipment.
3. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.


1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

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 will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M].
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 according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

   1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.
D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION
SECTION 05 31 00 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Roof deck.
   2. Composite floor deck.

B. Related Requirements:
   1. Division 03 Section "Cast-in Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
   2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
   3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
   4. Division 09 Painting Sections for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.
C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."


1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. 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.
C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings 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."

2.2 ROOF DECK

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. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Canam United States; Canam Group Inc.
   4. New Millennium Building Systems, L.L.C.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer. Color: Gray or White
   2. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 33 minimum, AZ50 aluminum-zinc-alloy coating.
   3. Deck Profile: As indicated
   4. Profile Depth: As indicated
   5. Design Uncoated-Steel Thickness: As indicated
   6. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated
   7. Span Condition: As indicated.
   8. Side Laps: Overlapped

2.3 COMPOSITE FLOOR DECK

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. Canam United States; Canam Group Inc.
   2. CMC Joist & Deck.
   4. Epic Metals Corporation.
6. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
   2. Profile Depth: As indicated.
   3. Design Uncoated-Steel Thickness: As Indicated.

C. Span Condition: As indicated

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Galvanizing Repair Paint: [ASTM A 780] [SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight].
K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
   1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
   1. Weld Diameter and Spacing: As indicated on the drawings.
   2. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches, and as follows:
   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
   2. Mechanically clinch or button punch.
   3. Fasten with a minimum of 1-1/2-inch long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least 1 weld at each corner.

E. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
   1. Weld Diameter and Spacing: As indicated.
   2. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches (910 mm), and as follows:
   1. Mechanically fasten with self-drilling No. 10 (4.8-mm-) diameter or larger carbon-steel screws.
2. Mechanically clinch or button punch.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
   1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. Floor Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.

F. Install piercing hanger tabs not more than 14 inches (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) from walls at sides, unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

A. Galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
   2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 9 Section.
C. Repair Painting: Wire brushing, cleaning and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 9.

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION
SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Load-bearing wall framing.
   2. Exterior non-load-bearing wall framing.
   3. Floor joist framing.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
   2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
   3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.
1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.
PART 2 - PRODUCTS

2.1 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. Building Products Division.
   2. Dietrich Metal Framing; a Worthington Industries Company.
   3. MarinoWARE.
   4. Steel Network, Inc. (The).
   5. Steeler, Inc.
   7. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

   1. Design Loads: As indicated.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

      b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
      c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.
      d. Floor Joist Framing: Vertical deflection of 1/480 for live loads and 1/240 for total loads of the span.
      e. Roof Rafter Framing: Vertical deflection of 1/360 of the horizontally projected span for live loads.

   3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:


5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:

2. Wall Studs: AISI S211.
3. Headers: AISI S212.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E119; 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.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

   1. Grade: As required by structural performance.
   2. Coating: G60 (Z180)

B. Steel Sheet for Vertical Deflection Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

   1. Grade: As required by structural performance.
   2. Coating: G60 (Z180).

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths, flange widths, and minimum metal thickness as indicated and punched with stiffened flanges.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths as indicated, unpunched, with straight flanges.
C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Vertical Deflection Clips: Manufacturer's standard slide clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

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. Dietrich Metal Framing; a Worthington Industries company.
   b. MarinoWARE.
   c. Steel Network, Inc. (The).
   d. Steeler, Inc.

B. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch
2. Minimum Flange Width: 1 inch

2.6 FLOOR JOIST FRAMING

A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched, with stiffened flanges.

B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
9. Joist hangers and end closures.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

   1. Anchor Spacing: 48 inches.
B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
   1. Stud Spacing: 600 mm, As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI 3200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
   2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
   1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches. Fasten at each stud intersection.
   1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

   a. Install solid blocking at 96-inch centers

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches from abutting walls, and as follows:
   1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
   1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:
   1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
   2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.
3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION
SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel, aluminum, and cast iron items.
B. Prefabricated ladders and ship ladders.

1.2 REFERENCE STANDARDS

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
J. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric).


N. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

O. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

P. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel.

Q. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

R. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's data sheets on each ladder safety system product to be used, including installation instructions.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
      a. Include the following, as applicable:
         1) Design criteria.
         2) Engineering analysis depicting stresses and deflections.
         3) Member sizes and gages.
         4) Details of connections.
         5) Support reactions.
         6) Bracing requirements.

C. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.4 QUALITY ASSURANCE

A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.
B. Steel Tubing: ASTM A500/A500M, Grade B cold-formed structural tubing.
C. Plates: ASTM A283/A283M.
D. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
E. Slotted Channel Fittings: ASTM A1011/A1011M.
F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
H. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
C. Aluminum-Alloy Bars: ASTM B211 (ASTM B211M), 6061 alloy, T6 temper.
D. Bolts, Nuts, and Washers: Stainless steel.
E. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.3 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FABRICATED ITEMS

A. Ladders: Aluminum; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.

B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of masonry; galvanized finish.

C. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

2.5 PREFABRICATED LADDERS

A. Prefabricated Roof Access Ladder (Keynote 055000-M): Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
   1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
   4. Size: As indicated on drawings.
   5. Manufacturers:
      d. Or approved equal.

B. Prefabricated Fixed Access Ladder (Keynote: 055000-N): Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
   1. Components: Manufacturer's standard rails, rungs, treads, and safety devices complying with the requirements of the MATERIALS article of this section.
   4. Size: As indicated on drawings.
   5. Manufacturers:
c. Or approved equal.

2.6 DOWNSPOUT NOZZLES

A. Downspout Nozzles (Keynote: 055000-R):
   1. Application: Overflow drainage, location as indicated on drawings.
   2. Material: Cast Nickel Bronze
   3. Size: As indicated on drawings.
   4. Manufacturers Basis of Design:
      a. Zurn Industries, LLC: "Z199 Downspout Nozzle"; www.zurn.com/#sle
      b. MIFAB, Inc.: "R1940 Series - Downspout Nozzle"; www.mifab.com/#sle
      c. Or approved equal.

2.7 FINISHES - STEEL

A. Prime paint steel items.
   1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.

B. Prime Painting: One coat.

2.8 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Class I color anodized.

B. Interior Aluminum Surfaces: Class I natural anodized.

C. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

D. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.9 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.
PART 3  EXECUTION

3.1  EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2  PREPARATION

A. Clean and strip aluminum where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3  INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

D. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4  TOLERANCES

A. Maximum Variation From Plumb:  1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment:  1/4 inch.


END OF SECTION 05 50 00
SECTION 05 51 00 - METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prefabricated stairs.
B. Structural steel stair framing and supports.

1.2 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
H. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
J. AWS D1.1/D1.1M - Structural Welding Code - Steel.
L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
1.3 SUBMITTALS

A. Product Data: Provide ______________.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.

1.4 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Prefabricated Metal Stairs:
   1. Lapeyre Stair, Inc; www.lapeyrestair.com/#sle.
   4. Or approved equal.

2.2 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
   2. Structural Design: Provide complete stair and railing assemblies complying with the applicable local code.
   3. Dimensions: As indicated on drawings.
   4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
   6. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.3 PREFABRICATED STAIRS (KEYNOTE: 055100-B)

A. Prefabricated Egress Stairs: Welded unit, factory fabricated to greatest degree practical and in the largest components possible.

1. Design Requirements: Comply with structural design criteria stated elsewhere in this section and applicable local code.
   a. Comply with ADA Standards.
   b. Comply with applicable sections of the IBC.

2. Materials: Manufacturer's standard steel tubes, plates, bars, shapes, sheets, wire and mesh complying with the requirements of the MATERIALS article of this section.
   a. Rails: Manufacturer's standard rails.
      1) Guardrails: 42 inches high.
      2) Handrails: 30 inches to 38 inches high.
   b. Treads: Manufacturer's standard diamond plate.
   c. Finish: Powder coat; color to be selected by Architect from manufacturer's standard range.

2.4 HANDRAILS AND GUARDS

A. Pipe railings as specified in Section 05 52 13.

2.5 MATERIALS

A. Steel Sections: ASTM A 36/A 36M.

B. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.

C. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.

1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).

2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).

2.6 ACCESSORIES

A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. When field welding is required, clean and strip primed steel items to bare metal.

B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

F. Obtain approval prior to site cutting or creating adjustments not scheduled.

G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 05 51 00
SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stair railings.

B. Free-standing railings site retaining wall.

1.2 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.


E. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

1.3 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
   1. Include the design engineer's seal and signature on each sheet of shop drawings.

B. Designer's Qualification Statement.

1.4 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
PART 2 PRODUCTS

2.1 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E 935.

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E 935.

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.

G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.2 STEEL RAILING SYSTEM

A. Steel Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.

B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

C. Exposed Fasteners: No exposed bolts or screws.

D. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.
C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION
   A. Clean and strip primed steel items to bare metal where site welding is required.
   B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.3 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
   C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
   D. Anchor railings securely to structure.
   E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.4 TOLERANCES
   A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
   B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 05 52 13
SECTION 055964 - GALVANIZED STEEL ANIMAL CAGING & KEEPER GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Fabrication and installation of all animal caging and keeper gates. All work of this Specification Section shall be fabricated of Galvanized Steel, unless specifically noted otherwise. Items fabricated and installed under this Section includes, but is not necessarily limited to:

1. Wire Mesh Caging Panels.
2. Shop Fabricated Galvanized and Welded Ferrous Metal Framing for Animal Caging.
4. Requirements for constructing full-scale operable mock-ups.
5. Benches
6. Feeders
7. Misc. Shop Fabricated Galvanized Ferrous Metal Items Required for a Complete and Proper Installation.
8. Finish Hardware and Schedule.

1.2 RELATED DOCUMENTS

A. Division 05 “Galvanized Animal Transfer Door Assemblies:” Requirements for Steel Animal Transfer Door.
B. Division 05 “Metal Fabrications.”

1.3 PRE-QUALIFIED METAL FABRICATORS AND INSTALLERS

A. Only Subcontractors whose experience and workmanship that have been previously reviewed and pre-qualified by the Architect/Exhibit Designer for the Work of this Section. Qualifications for companies include a minimum of five (5) years of experience in metal work of this type, plus a minimum of three (3) similar projects involving containment of animals. Companies requesting consideration shall submit written and photographic proof of previously performed projects.

B. Subject to the compliance with the requirements of these Specifications, pre-qualified fabricators and installers for galvanized steel gaging fabrication and installation include but are not limited to the following:

A thru Z Consulting and Distributing, Inc.
8620 E. Old Vail Road, Suite 100
Tucson, AZ 85747
Phone: (520) 434-8281
Thermeq Co.
1070 Disher Drive
Waterville, Ohio 43566
Phone: (419) 878-4400

Corners Limited
841 Gibson Street
Kalamazoo, MI 49001
Phone: 1(800) 456-6780
(For Small Animal Holding only)

1.4 REFERENCES

A. ASTM A36 Structural Steel.

B. ASTM A53 Hot Dipped, Zinc coated Welded and Seamless Steel Pipe.

C. ASTM F3125 High Strength Bolts for Structural Steel Joints.

D. ASTM A123 Zinc Coating (Hot Dip) on Assembled Steel Products.

E. ASTM A500 Cold formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

F. ASTM A501 Hot formed Welded and Seamless Carbon Steel Structural Tubing.

G. AWS D1.1 Structural Welding Code.


I. ASTM A780 Repair of Damaged Hot-Dip Galvanized Coatings

1.5 FIELD MEASUREMENTS

A. Prior to submission of shop drawings, the Caging Contractor shall verify that all field measurements are as indicated on Caging Drawings (CG) and Schedules, and notify the Architect (GWWO) in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.

1.6 SUBMITTALS

A. Pre-detailing Conference: Contractor shall schedule and hold a prefabrication meeting at the site or by phone (Skype, GO-TO) to coordinate specification and shop drawing issues prior to the
first shop drawing submittal. Attendees shall include the contractor’s project manager, the
detailer, the fabricator, the erector, the structural engineer of record and the testing agency.

B. Submit Shop Drawings, Product Data, Field Mock-up and Samples to the requirements relevant
to Division 01 Section “Submittal Procedures”.

C. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of
      fasteners, and accessories.
   2. Include erection drawings, elevations, and details where applicable. Indicate welded
      connections using standard AWS welding symbols. Indicate net weld lengths.

D. Product Data: Provide product data on padlocks, sprockets, ball-screw assemblies, finish paint
systems, and other pertinent items.

E. Samples: Submit one 24” x 24” sample of each mesh type and size specified, showing typical
termination conditions, typical welded connections, and other pertinent construction
components. See CG drawings.

F. Full-Scale Mock-Up: Refer to 1.7 below for requirements.

G. Production runs of all components shall be contingent on the results of the review process and
acceptance of the working mock-up.

1.7 FULL-SCALE MOCK-UPS

A. Prior to the construction of exterior building walls and exhibit spaces, and immediately upon
receipt of the notice-to-proceed with construction work, the Contractor shall be required to
construct "mock-up" panels at the project site using exposed construction materials, bonding,
tooling and reinforcement to be utilized in the actual construction. Obtain Architect's written
approval of the "mock-up" panel prior to starting actual construction work. Provide mock-up
panels with applicable sized concrete and/or masonry footings as follows:
   1. Panel for Keeper Gates: One (1) of each type, full scale mesh panel and gate assembly
      utilizing mesh, keeper gates, framing and operating hardware and mechanisms indicated
      in the construction documents. Panel shall demonstrate actual workmanship and
      operation expected in the completed work.
   2. Caging Panels: Cage Front: One (1) of each type, full-scale cage front utilizing
      components as indicated in the construction documents. Panel shall demonstrate actual
      workmanship and operation expected in completed work. Small animal holding and
      Medium/Large Animal holding.

B. All mock-ups shall serve to demonstrate construction methods, operability (where required),
finishes, etc.

C. Coordinate field reviews of all mock-ups with representatives of Owner and Architect. Make
all adjustments required by the Owner and/or Architect at no additional cost to the Project. If
significant adjustments are required, schedule an additional review with the required parties.
D. Obtain from the Owner and Architect written statements accepting mock-ups as the basis for construction of the respective assemblies and systems. Do not begin fabrication of any affected assemblies until written acceptance is obtained.

E. Do not alter, move or destroy "mock-up" panels until approval is granted or as otherwise directed by the Architect. Damage or destruction of the panel prior to approval shall be cause for its replacement at the expense of the Contractor.

F. Mock-ups may remain as part of the final work if accepted by the Owner and Architect. Mock-ups that are not to remain as part of the Final Work shall be dismantled and removed off-site.

PART 2 - PRODUCTS

2.1 MESH PANELS ASSEMBLIES

A. Welded Wire Mesh Panel Assemblies: All mesh panel assemblies shall be fabricated from steel components, comprised of the materials indicated on the drawings. Mesh panels shall be installed where indicated, as animal caging, keeper gates, and elsewhere as indicated.

1. All Mesh Panel Assemblies shall be galvanized after fabrication, to a minimum of G-90 coating designation (ASTM A-653).
   a. All Mesh Panel Assemblies shall be free from warp after galvanizing.
   b. Sharp drips left on mesh after galvanizing

B. Steel Sections: ASTM A36, galvanized.

C. Steel Tubing: Galvanized steel in shapes and sizes indicated on the Drawings conforming with ASTM A501.

D. Cords and Wires: Stainless Steel. For Guillotine Doors

E. Fasteners, Bolts, Nuts, and Washers: ASTM A325; all bolts, machine screws and fasteners shall be either torx or hex socket round head and flat head as indicated on the drawings except where specifically noted otherwise.

F. Welding Materials: AWS D1.1; type required for materials being welded.

G. Touch up Primer for Galvanized Surfaces: ZRC or approved equal to match color of galvanized panels for all field welded surfaces. Cold galvanizing is intended for limited touch-up only and will be acceptable only for those areas necessary for field welds.

H. Exposed Mechanical Fastenings: Flush countersunk torx or hex socket machine screws and bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

I. Anchor Bolts: Hilti countersunk flathead hex socket "kwik-Bolts" for installation in monolithic concrete and chemical expansion hit-anchors for concrete block walls in sizes indicated on the Drawings, unless specifically noted otherwise.
J. Galvanized steel assemblies shall be free from burrs. Grind smooth all assemblies prior to galvanization.

2.2 GATE HARDWARE AND KEYING

A. Refer to caging schedules and details on caging drawings.

B. Substitutions: All substitutions for the hardware of this Section must be reviewed and approved by the Architect/Exhibit Designer and Owner prior to Bid acceptance.

C. Keying – coordinate all keying with the Project General Contractor and the requirements of Division 08 Section “Door Hardware”, in the Specifications for the overall Project.

D. Hinges:
   1. Where hinges are specified for keeper gate and heavy-duty doors, they shall be greasable barrel hinges or box hinges sized for weight of door assembly.
   2. Unless scheduled otherwise, furnish one pair of hinges for doors up 60" high. Furnish one additional hinge for every 30" additional of fraction thereof. Exterior doors or gates shall be furnished with hinges of non-ferrous metal. Where hardware sets are marked “non ferrous” furnish non-ferrous metal hinges. All exterior doors, which open at reverse bevel, shall be furnished with NFRP hinges.

E. Padlocks:
   1. Padlocks will be provided by Owner.

F. Door Pulls
   1. See drawings.

G. Slide Bolts & Staples:
   1. See drawings.

H. Cane Bolts:
   1. See drawings.

I. Spring Bolts:
   1. See drawings.

J. Padlocks Tabs:
   1. As indicated on Drawings.

K. Silencers:
   1. All interior doors shall be furnished with rubber silencers. Furnish 3 for single doors and 2 for pairs of doors. Silencers can be put on gate and door stop plates.
2. Silencers shall be furnished loose by the steel frame supplier. Holes in frames ‘stop-strip’ shall be factory drilled for a snap-in silencer installation. Glued on or adhesive back silencers are unacceptable.

L. Finishes:

1. Unless otherwise noted, all hardware shall be furnished in accordance with the following list:
   a. Pulls, push, kick plates US32D (630)
   b. Lock trim, Exit devices US32D (630)
   c. Hinges, Misc. (ferrous) US26D (652)
   d. Hinges, Misc. (non-ferrous) US26D (626)

2.3 SEALANT

A. Epoxy Sealant: Provide an epoxy sealant. Refer to Division 07 Section “Joint Sealants.”

2.4 FABRICATION

A. Verify dimensions on site prior to shop fabrication.

B. Fabricate items with joints tightly fitted and secured. Make exposed joints butt tight, flush, and hairline.

C. Continuously seal joined members by continuous welds.

D. Fit and shop assemble in largest practical sections, for delivery to site.

E. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.

F. Exposed Mechanical Fastenings: Flush countersunk torx or hex socket machine screws and bolts; stainless steel finish; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Anchor Bolts: Hilti countersunk flathead hex socket "Kwik-Bolts", stainless steel finish, for installation in monolithic concrete and chemical expansion hit-anchors for concrete block walls in sizes indicated on the Drawings, unless specifically noted otherwise.

2.5 SHOP – APPLIED PROTECTIVE COATING:

A. Shop-apply a thin layer of surface oil as a protective coating of all galvanized products prior to shipment to Project site.

PART 3 - EXECUTION

3.1 PREPARATION
A. Verify that field conditions are acceptable and are ready to receive work. Do not install until any unsatisfactory conditions are corrected. Beginning Work constitutes contractor's acceptance of conditions as satisfactory.

B. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.

C. Clean and strip site primed steel items to bare metal where site welding is scheduled.

D. Make provision for erection loads with temporary bracing. Keep work in alignment.

E. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate trades.

3.2 COORDINATION

A. Coordinate all material requirements with other pertinent specification Sections relevant to the Work of this Section.

3.3 PREPARATION OF STEEL ASSEMBLIES

A. Verify dimensions on site prior to shop fabrication.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Fabricate items with joints tightly fitted and secured. Make exposed joints butt tight, flush, and hairline. All oversized holes required for fabrication shall be welded & plugged. No holes, cavities, or other voids will be acceptable, unless specifically designed into the caging system.

D. Continuously seal joined members by continuous welds.

E. Fit and shop assemble in largest practical sections, for delivery to site.

F. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius of 1/8". Radius all corners to 1/4".

G. Galvanized items to minimum 2.0 oz./sq. ft zinc coating in accordance with ASTM A123.

H. Do not prime surfaces in direct contact bond with concrete or where field welding is required. Prime paint items scheduled with one coat.

3.4 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Perform field welding in accordance with ASW D1.1.

C. After installation, touch-up field welds, scratched or damaged surfaces with specified touch-up primer.

D. Remove all sharp edges, burrs, corners and slivers that, in the opinion of the Architect, and/or Owner could injure animals or keepers.
E. Apply specified sealant to all gaps in any of the following areas:

1. Between adjacent construction.
2. Where specifically detailed.
3. Where required to comply with the Animal Management Requirements of Construction procedures listed elsewhere in this Specification Section

3.5 WELDING REQUIREMENTS

A. All exposed welds shall be ground smooth and galvanized.

B. Remove all sharp edges, burrs, corners, and slivers, which in the opinion of the Architect and/or Owner, could injure animals or keepers.

3.6 ANIMAL MANAGEMENT AND REQUIREMENTS OF CONSTRUCTION

A. The following work items shall be installed and/or performed as part of the Base Work of this Section, whether or not specifically detailed or noted on the Drawings:

1. Exposed threaded bolts/studs shall be cut back to a maximum 1/8” projection wherever they occur within animal spaces. Bolt threads to remain operational after cutting.

2. All gaps larger than 1” clear between installed items and new construction, shall have a continuous section of 12ga galvanized steel plate welded to post to reduce gaps to 1” or less. This does not apply to any larger gaps specifically detailed (as indicated on the drawings) into the work of this section.

3. Guard plates fabricated from 12ga galvanized steel shall be installed wherever exposed cables on the keeper side occur within 12” from the face of any gap in the construction. These guard plates shall be welded to the construction and extend minimum of 4” beyond the cables in any direction.

4. Cover plates to be fabricated from 12ga galvanized steel and be installed wherever exposed cables, plumbing lines, and electrical lines occur within animal holding rooms, or within animal reach through and/or over caging. Cover plates to be field bolted ¼” dia bolts at 24” o.c.

5. In order to minimize vermin infestation, all gaps occurring in any adjoining construction shall be caulked and sealed tight with the specified epoxy sealant to the requirements of Division 07.

END OF SECTION 05 59 64
SECTION 055966 - GALVANIZED ANIMAL TRANSFER DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Fabrication and installation of all animal transfer door assemblies, complete, and fully operational. All work of this Section shall be fabricated of Galvanized Steel, unless specifically noted otherwise. Items fabricated and installed under this Section includes, but is not limited to:

1. Cable-operated door assemblies.
2. Push-pull bar sliding door assemblies
3. Cover panels and plates.
4. Locking mechanisms.
5. Misc. shop fabricated operating hardware and steel shapes.
6. Requirements for constructing full-scale mock-ups.

1.2 RELATED DOCUMENTS

A. Division 05 Section “Galvanized Steel Animal Caging and Keeper Gates”: Requirements for animal caging and keeper gates.
B. Division 05 Section “Metal Fabrications.”
C. Division 01 Section “Animal Management Requirements of Construction.”

1.3 PRE-QUALIFIED FABRICATORS AND INSTALLERS

A. Fabricator/Installer shall be the same as identified in Division 05 Section “Galvanized Steel Animal Caging and Keeper Gates.”

1.4 REFERENCES

A. ASTM A36 Structural Steel.
B. ASTM A53 Hot Dipped, Zinc coated Welded and Seamless Steel Pipe.
C. ASTM F3125 High Strength Bolts for Structural Steel Joints.
D. ASTM A123 Zinc Coating (Hot Dip) on Assembled Steel Products.
E. ASTM A653 Sheet Steel, Zinc-Coated by the Hot-Dipped Process, Structural Quality.
F. ASTM A500 Cold formed Welded and Seamless Carbon Steel Structural Tubing

G. ASTM A501 Hot formed Welded and Seamless Carbon Steel Structural Tubing.


I. AWS D1.1 Structural Welding Code.

1.5 FIELD MEASUREMENTS

A. Prior to submission of shop drawings, the Transfer Door Contractor shall verify that all field measurements are as indicated on Caging Drawings (CG) and Schedules, and notify the Architect in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.

1.6 SUBMITTALS

A. Pre-detailing Conference: Contractor shall schedule and hold a prefabrication meeting at the site or by phone (Skype, GO-TO) to coordinate specification and shop drawing issues prior to the first shop drawing submittal. Attendees shall include the contractor's project manager, the detailer, the fabricator, the erector, the structural engineer of record and the testing agency.

B. Submit Shop Drawings, Field Mock-Up, and Samples to the requirements of the items specified in this Section.

C. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   2. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
   3. Transfer Door Contractor to review and coordinate with steel fabrication and caging drawings prior to submitting transfer door drawings to Architect and Engineer.

D. Samples:
   1. Submit two (2) samples each of sheaves, cables, galvanized cover plates (6 inches long), and door material (8 inch x 8 inch).

E. Product Data: Provide manufacturer's engineering data and other pertinent product data for door operators, door hardware, wire rope, cables, pulleys, sprockets, polypropylene, tracks and trucks, etc.

F. Full-Scale Mock-Up: Refer to 1.7 below for requirements.

G. Production runs of all components shall be contingent on the results of the submittal and review process.
1.7 FULL SCALE MOCK-UPS

A. The Contractor shall be required to construct "mock-up" panels at the project site using exposed construction materials, bonding, tooling and reinforcement to be utilized in the actual construction. Obtain Architect's written approval of the "mock-up" panel prior to starting actual construction work.

1. Panel for Transfer Door Assemblies: One mock-up for each transfer door type is required. Construct two (2) concrete panels 8" thick utilizing typical transfer door assembly; and operating mechanisms indicated in the construction documents. Panels shall demonstrate actual workmanship and operation expected in the completed work. Include all cables, winches, counterweights, etc. to indicate full range of operation.

B. All mock-ups shall serve to demonstrate construction methods, operability, finishes, etc.

C. Coordinate field reviews of all mock-ups with representatives of Owner and Architect. Make all adjustments required by the Owner and/or Architect at no additional cost to the Project. If significant adjustments are required, schedule an additional review with the required parties.

D. Obtain from the Owner and Architect written statements accepting mock-ups as the basis for construction of the respective assemblies and systems. Do not begin fabrication of any affected assemblies until written acceptance is obtained.

E. Do not alter, move or destroy "mock-up" panels until approval is granted or as otherwise directed by the Architect. Damage or destruction of the panel prior to approval shall be cause for its replacement at the expense of the Contractor.

F. Mock-ups may remain as part of the final work if accepted by the Owner and Architect. Mock-ups that are not to remain as part of the Final Work shall be dismantled and removed off-site.

1.8 WARRANTY

A. Submit the following written warranty:

1. The fabricator/installer shall provide the Owner with a written warranty, signed and notarized, guaranteeing the materials, workmanship, and operation of the caging systems for a period of not less than one (1) year from the date of 'substantial completion'. This warranty shall be separate from any other materials or operations warranty that may or may not be supplied by any parts supplier or manufacturer. Any defective materials, inadequate operation, or general failure of the system or any portion thereof during the warranty period, shall be the sole responsibility of the fabricator/installer.

B. Replace any defective materials with new materials furnished by the fabricator/installer at no cost to the Owner if failure occurs during the warranty period.
PART 2 - PRODUCTS

2.1 MATERIALS FOR FABRICATED ASSEMBLIES

A. Steel Sections: Galvanized steel as indicated on the Drawings conforming with ASTM A36.

B. Steel Cover Plate: 12 ga. steel sheet, galvanized to the requirements of ASTM A653, G165 coating designation. All sheet steel shall be pre-drilled for fasteners prior to galvanizing process. Maximum lengths shall be 15 feet.

C. Steel Tubing: Galvanized steel in shapes and sizes indicated on the Drawings conforming with ASTM A501.

D. Cable: 7 x 19 extra flexible stainless steel cable sized accordingly for weight of associated doors, in lengths as indicated on the Drawings for proper operation, as manufactured by:

   1. MacWhyte Wire Rope Co., Kenosha, WI, 53141.

E. HDPE Doors: Molded sheet with machined edges of sizes indicated on the Drawings. Provide standard colors for owner selection.

F. Sheaves: Fabricated as detailed on the Drawings.

G. Bolts, Nuts, and Washers: ASTM F3125; all bolts, machine screws and fasteners shall be either torx or hex socket round head and flat head as indicated on the drawings except where specifically noted otherwise.

H. Welding Materials: AWS D1.1; type required for materials being welded.

I. Touch up Primer for Galvanized Surfaces: ZRC or approved equal to match color of galvanized panels for all field welded surfaces. Cold galvanizing is intended for limited touch-up only and will be acceptable only for those areas necessary for field welds.

J. Galvanized steel assemblies shall be free from burrs. Grind smooth all assemblies prior to galvanization.

K. Counter Weight Material: Any material suitable in providing the required minimum weight. Material may include sand, steel plates, lead plates, stones, etc. Assembly must be sealed and protected from animals.

L. Epoxy Sealant: Provide an epoxy sealant. Refer to Division 07 Section “Joint Sealants.”

M. Assemblies called out to be stainless steel shall be Type 304.

2.2 FABRICATION

A. Verify dimensions on site prior to shop fabrication.
B. Fabricate items with joints tightly fitted and secured. Make exposed joints butt tight, flush, and hairline.

C. Continuously seal joined members by continuous welds.

D. Fit and shop assemble in largest practical sections, for delivery to site.

E. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.

F. Exposed Mechanical Fastenings: Flush countersunk torx or hex socket machine screws and bolts; stainless steel finish; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Anchor Bolts: Hilti countersunk flathead hex socket "Kwik-Bolts", stainless steel finish, for installation in monolithic concrete and chemical expansion hit-anchors for concrete block walls in sizes indicated on the Drawings, unless specifically noted otherwise

2.3 SHOP–APPLIED PROTECTIVE COATING:

A. Shop-apply a thin layer of surface oil as a protective coating of all galvanized products prior to shipment to Project site.

2.4 FINISHES

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Radius all corners 1/4"and ease all edges 1/8".

C. Do not prime surfaces in direct contact bond with concrete or where field welding is required.

D. Prime paint items scheduled with one coat.

E. Unless specified otherwise, galvanize items to minimum 2.0 oz/sq. ft. zinc coating in accordance with ASTM A123.

2.5 HARDWARE

A. As indicated on drawings.

B. Padlocks: Owner will provide padlocks

PART 3 - EXECUTION

3.1 PREPARATION
A. Verify that field conditions are acceptable and are ready to receive work. Do not install until any unsatisfactory conditions are corrected. Beginning Work constitutes contractor's acceptance of conditions as satisfactory.

B. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.

C. Clean and strip site primed steel items to bare metal where site welding is scheduled.

D. Make provision for erection loads with temporary bracing. Keep work in alignment.

E. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate trades.

3.2 FABRICATION OF STEEL ASSEMBLIES

A. Verify dimensions on site prior to shop fabrication.

B. Fabricate items with joints tightly fitted and secured. Make exposed joints butt tight, flush, and hairline.

C. Continuously seal joined members by continuous welds.

D. Fit and shop assemble in largest practical sections to minimize field welding to site.

E. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Perform field welding in accordance with AWS D1.1.

C. After installation, touch up field welds, scratched or damaged surfaces with specified touch-up primer.

D. Remove all sharp edges, burrs, corners and slivers which, in the opinion of the owner and Architect, could injure animals or caregivers.

E. Apply specified sealant to all gaps in any of the following areas:
   1. Between adjacent construction.
   2. Where specifically detailed.
   3. Where required to comply with the Animal Management Requirements of Construction procedures listed elsewhere in this Specification Section.

3.4 COUNTERWEIGHT ASSEMBLIES
A. Counterweight assemblies shall be filled enough weight material to within 5 pounds less than the total weight of the transfer door.

3.5 ANIMAL MANAGEMENT REQUIREMENTS OF CONSTRUCTION

A. The following work items shall be installed and/or performed as part of the Base Work of this Section, whether or not specifically detailed or noted on the Drawings:

1. Refer to Specification Division 01 - Animal Management Requirements of Construction and drawings for the following requirements:
   a. Fastener requirements including exposed threading, projections, and spot welding in animal spaces.
   b. Maximum gap requirements between installed items, installed items and existing construction.
   c. Protective guard and cover plating requirements on interior and adjacent exterior animal spaces.

2. In order to minimize vermin infestation, all gaps occurring in any adjoining construction shall be caulked and sealed tight with the specified epoxy sealant to the requirements of Division 07.

END OF SECTION 055966
SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural dimension lumber framing.
B. Non-structural dimension lumber framing.
C. Rough opening framing for doors, windows, and roof openings.
D. Sheathing.
E. Underlayment.
F. Roof-mounted curbs.
G. Roofing nailers.
H. Preservative treated wood materials.
I. Fire retardant treated wood materials.
J. Miscellaneous framing and sheathing.
K. Communications and electrical room mounting boards.
L. Concealed wood blocking, nailers, and supports.
M. Miscellaneous wood nailers, furring, and grounds.

1.2 REFERENCE STANDARDS

F. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings.


H. PS 1 - Structural Plywood.

I. PS 2 - Performance Standard for Wood-Based Structural-Use Panels.


PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

C. Provide sustainably harvested wood; see Section 01 60 00 - Product Requirements for requirements.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.3 EXPOSED TIMBERS (KEYNOTE: 061000-I)

A. Sizes: Nominal sizes as indicated on drawings.

B. Moisture Content: S-dry (19 percent maximum).

C. Surfacing: S4S.
D. Species: Douglas Fir.

E. Grade: Select Structural.

2.4 METAL ANCHORS

A. Simpson Strong Tie™ or approved equal

B.

2.5 CONSTRUCTION PANELS

A. Roof Sheathing, Keynote: 061000-E: Any PS 2 type, rated Structural I Sheathing.
   2. Span Rating: 60.
   3. Performance Category: 5/8 PERF CAT.

B. Wall Sheathing, Keynote: 061000-F: Plywood, PS 1, Grade C-D, Exposure I.

C. Wall Sheathing, Keynote: 061000-H: Gypsum, complying with requirements of ASTM C1396/C1396M for gypsum sheathing, square long edges, 1/2 inch.

D. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.6 ACCESSORIES

A. Fasteners and Anchors:
   2. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
   3. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities have jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 as appropriate for the substrate.

B. Metal Framing Anchors
   1. "Simpson Strong Tie" or approved equal.
   2. Allowable design loads, 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. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

4. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
   a. Use for wood-preservative-treated lumber and where indicated.

C. Sill Flashing: As specified in Section 07 62 00.

D. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed.

2.7 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat all exterior rough carpentry items.
      c. Do not use treated wood in direct contact with the ground.
   2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. All interior rough carpentry items are to be fire retardant treated.

C. Preservative Treatment:
a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
b. Treat lumber exposed to weather.
c. Treat lumber in contact with roofing, flashing, or waterproofing.
d. Treat lumber in contact with masonry or concrete.
e. Treat lumber less than 18 inches above grade.
f. Treat lumber in other locations as indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing
continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.

B. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as
accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and
immediately after installation sufficient to remove indoor air contaminants.

3.3 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that
would lower required strength or result in unacceptable appearance of exposed
members.

B. Make provisions for temporary construction loads, and provide temporary bracing
sufficient to maintain structure in true alignment and safe condition until completion of
erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically
detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and
spacing indicated, but not less than required by applicable codes and AWC (WFCM)

E. Install metal framing anchors to comply with manufacturer's written instructions. Install
fasteners through each fastener hole.
F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.4 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

D. Provide the following specific non-structural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Grab bars.
   4. Towel and bath accessories.
   5. Wall-mounted door stops.

3.5 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.6 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. Nail panels to framing; staples are not permitted.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.
3.7 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.8 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.9 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 74 19 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00
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. This Section includes the following:
      1. Roof sheathing.
      2. Wall sheathing
      3. Subflooring and underlayment

1.3 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. 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.

1.4 DELIVERY, STORAGE, AND HANDLING
   A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
      1. Fire-Resistance Ratings: Indicated by design designations from UL’s “Fire Resistance Directory.”.

2.2 WOOD PANEL PRODUCTS
   A. Plywood: DOC PS 1.
B. Oriented Strand Board: DOC PS 2.

C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

D. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Plywood in contact with masonry or concrete, or used with flashing, vapor barriers, and waterproofing.

2.4 WALL SHEATHING

A. Wall Sheathing
   1. Oriented-Strand-Board Wall Sheathing: 1/2 inch thick 32/16 span rated APA Structural I Rated OSB sheathing with integral water-resistive barrier, Exposure 1 sheathing.
   2. Nominal Thickness: Not less than 1/2 inch.

2.5 ROOF SHEATHING

A. Plywood Roof Sheathing: 5/8 inch thick 32/16 span rated APA Structural I Rated Plywood sheathing Exposure 1 sheathing.
   1. Span Rating: Not less than 24/0.
   3. Grade C-D sanded One Side, install good side up.
   4. Provide fire retardant treatment where noted on the Drawings.

B. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Fire-Retardant-Treated 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. Use treatment that does not promote corrosion of metal fasteners.
   2. Treatment used shall be suitable for 60 days of weather exposure without degredation of treatment.
3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings required by framing spacing.

D. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

E. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

2.6 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: 3/4” thick 20 span rated APA Sturdi-Floor Exposure 1 OSB.
   1. Span Rating: Not less than 20’ o.c..
   2. Nominal Thickness: Not less than 3/4 inch
   3. Edges: Tongue and Groove.

B. Underlayment, General: 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.

C. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exposure 1 Underlayment with fully sanded face.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.


D. Wood Screws: ASME B18.6.1

E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-stray resistance of more than 800 hours according to ASTM B 117.

F. 1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.
   2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Securely attach to substrate by fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

B. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that exclude exterior moisture.

C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION


B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail to wood framing.
   2. Subflooring:
      a. Glue and nail to wood framing.
      b. Screw to cold-formed metal framing.
      c. Space panels 1/8 inch apart at edges and ends.
   3. Underlayment:
      a. Nail to subflooring, offsetting underlayment 1 inch around the bottom of base cabinet.
      b. Space panels 1/32 inch apart at edges and ends.
      c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

C. Apply seam tape to all wall sheathing panel joints and penetrations in accordance with manufacturer’s recommendations.

END OF SECTION
SECTION 07 13 00 - SHEET WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sheet Waterproofing:

1.2 ABBREVIATIONS


1.3 REFERENCE STANDARDS


B. NRCA (WM) - The NRCA Waterproofing Manual.

1.4 SUBMITTALS

A. Product Data: Provide data for membrane.

B. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

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

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.
1.7 WARRANTY

A. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 WATERPROOFING APPLICATIONS

A. Self-Adhered Modified Bituminous Sheet Membrane:
   1. Location: Use at all building walls as indicated on drawings.
   2. Cover with drainage panel where below grade, if drainage insulation board is not indicated on drawings.

2.2 MEMBRANE MATERIALS

A. Self-Adhered Modified Bituminous Sheet Membrane:
   1. Thickness: 60 mil, 0.060 inch, minimum.
   2. Sheet Width: 36 inch, minimum.
   3. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
   4. Tensile Strength:
      a. Film: 5000 pounds per square inch, minimum, measured according to ASTM D882 and at grip-separation rate of 2 inches per minute.
      b. Membrane: 325 pounds per square inch, minimum, measured according to ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches per minute.
   5. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
   6. Manufacturers:
      e. Or approved equal.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Sealant: As recommended by membrane manufacturer.

D. Termination Bars: Stainless steel; compatible with membrane and adhesives.
E. Surface Conditioner: Any type, compatible with membrane.

F. Adhesives: As recommended by membrane manufacturer.

G. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

2.3 ACCESSORIES

A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.

B. Protection Board: Rigid insulation specified in Section 07 21 00.

C. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
      a. Products:
         1) Epro Services, Inc; ECODRAIN-MS: www.eproserv.com.
         2) Mar-flex Waterproofing & Building Products; ArmorDrain 150:
         4) Or approved equal.

D. Flexible Flashings: Type recommended by membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.2 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
E. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate according to ASTM D5295/D5295M.
   1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
   2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delamination, as described in the reference standard.
   3. Remove and replace areas of defective concrete as specified in Section 03 30 00.
   4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in the referenced standard.
   5. Test concrete surfaces as described in the referenced standards. Verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

3.3 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

D. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

E. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

F. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

G. Seal membrane and flashings to adjoining surfaces.
   1. Install counterflashign over exposed edges.

3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.

B. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.
3.5 PROTECTION

   A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 07 13 00
SECTION 07 21 00 - THERMAL INSULATION

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Board insulation and integral vapor retarder at perimeter foundation wall, underside of floor slabs, and exterior wall behind wood siding and stucco wall finish.

B. Batt insulation in exterior wall and ceiling construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2  REFERENCE STANDARDS


F. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C.


1.3  SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

D. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.4 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.5 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

C. Insulation Inside Masonry Cavity Walls: Extruded polystyrene (XPS) board.

D. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene (XPS) board.

E. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
   1. Masonry Cavity Walls and over Metal Stud Framed Walls, Type and Compressive Resistance: Type X, 15 psi (104 kPa), minimum.
   2. Perimeter of Foundations, Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   3. Under Concrete Slabs, Type and Compressive Resistance: Type VI, 40 psi (276 kPa), minimum.
   4. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   5. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
6. Type and Thermal Resistance, R-value: minimum 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
8. Board Thickness: 2 inch.
10. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
11. Manufacturers:
   d. Or approved equal.

2.3 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
   2. Formaldehyde Content: Zero.
   3. Thickness as indicated on drawings.
   5. Thickness: 3 1/2 inch.
   7. Manufacturers:
      b. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
      c. Or approved equal.

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Thickness as indicated on drawings.

2.4 ACCESSORIES

A. Sheet Vapor Retarder: Black polyethylene film for above grade application, 10 mil, 0.010 inch thick.
B. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

C. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

D. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

E. Insulation Fasteners: Appropriate for purpose intended.
   1. Length as required for thickness of insulation material and penetration of deck substrate.

F. Protection Board for Below Grade Insulation: Cementitious, 1/4 inch thick.

G. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Adhere a 6 inch wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints.
   2. Extend sheet full height of joint.

B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
   2. Full bed 1/8 inch thick.

C. Install boards horizontally on foundation perimeter.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
3.3 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.

B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
   2. Full bed 1/8 inch thick.

C. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.4 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall and ceiling spaces without gaps or voids where indicated on drawings. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Retain insulation batts in place with wire mesh secured to framing members.

3.6 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 21 00
SECTION 07 25 00 - WEATHER BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor resistant and air tight.

1.2 REFERENCE STANDARDS


1.3 SUBMITTALS

A. Product Data: Provide data on material characteristics.

B. Shop Drawings: Provide drawings of special joint conditions.

C. Manufacturer's Installation Instructions: Indicate preparation.

D. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

E. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification; keep copies of each contractor accreditation and installer certification on site during and after installation, and present on-site documentation upon request.

1.4 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.
1.5 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.1 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

   1. Type: Rubberized asphalt bonded to thermoplastic sheet, self-adhesive.
   2. Thickness: 40 mil, 0.040 inch, nominal.
   4. Water Vapor Permeance: 0.05 perm, maximum, when tested in accordance with ASTM E96/E96M.
   5. Seam and Perimeter Tape: As recommended by sheet manufacturer.
   6. Manufacturers:
      d. Or approved equal.

2.2 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

B. Flexible Flashing: Sheathing fabric saturated with air barrier coating and complying with the applicable requirements of ICC-ES AC148.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.
3.3 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Air and Water-Resistive Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

D. Self-Adhered Sheets:
   1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
   2. Lap sheets shingle-fashion to shed water and seal laps air tight.
   3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fish mouths.
   4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.
   5. At wide joints, provide extra flexible membrane allowing joint movement.

3.4 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

B. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

END OF SECTION 07 25 00
SECTION 07 46 23 - WOOD SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board siding for walls with batten strips.
B. Trim, flashings, accessories, and fastenings.

1.2 REFERENCE STANDARDS

C. SPIB (GR) - Grading Rules.
D. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17.

1.3 SUBMITTALS

A. Product Data: Provide data indicating materials, component profiles, fastening methods, jointing details, sizes, surface texture, finishes, and accessories.
B. Samples: Submit two samples 12 inch by 12 inch in size to applicator of finish paint for use in preparation of finish samples.

1.4 QUALITY ASSURANCE

A. Grade lumber in accordance with the following:
   1. Western Red Cedar: WCLIB (GR).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store in ventilated areas with constant minimum temperature of 60 degrees F and maximum relative humidity of 55 percent.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wood Siding:
   1. 1 x 10 Western Red Cedar Board Siding.
   2. 1 x 2 Western Red Cedar Batten.
2.2 SIDING

A. Board Siding: Flat, western red cedar, WCLIB grade, maximum moisture content of 10 percent.
   1. Size: 1 inch thick, 10 inch wide nominal board with __ inch.
   2. Profile: Board and batten.
   5. Preservative Treatment: Pressure treatment in accordance with AWPA U1, using water borne preservative.

B. Batten Strips: Same species as siding; 1 inch by 2 inch.

2.3 ACCESSORIES

A. Preservative Treatment: Dip- or brush-type, non-discoloring.

B. Nails: Hot dipped galvanized type; non-staining, of size and strength to securely and rigidly retain the work; prefinished to match siding finish.

C. Flashing: 20 mil, 0.020 inch thick, black polyethylene.

D. Prime Paint: Latex base primer enamel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates are ready to receive work.

B. Verify that water-resistive barrier has been correctly and completely installed over substrate.

C. Do not begin until unacceptable conditions have been corrected.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Apply preservative treatment in accordance with manufacturer's instructions.
   1. Verify materials do not exceed specified percent moisture content before applying wood preservative treatment.
   2. Brush apply one coat of preservative treatment.

B. Apply dip- or brush-type preservative to site-sawn ends of pressure preservative treated materials, and allow preservative to cure prior to erecting materials.
C. Prime paint surfaces in contact with cementitious materials.

D. Do not install materials until site pre-finishing is complete and dry.

3.3 INSTALLATION

A. Install siding in accordance with manufacturer's instructions.

B. Fasten siding in place, level and plumb.
   1. Arrange for orderly nailing pattern, blind nail except over trim.
   2. Install siding for natural shed of water.
   3. Position cut ends over bearing surfaces, and sand cut edges smooth and clean.

C. Install panel siding sheets vertically with edges and ends over firm bearing.
   1. Space joints 1/4 inch.
   2. Nail at 16 inches on center.

D. Install corner strips, closures, trim, and battens.

E. Install metal flashings at internal and external corners, sills, and heads of wall openings.

F. Touch-up, repair, or replace wood siding materials having damaged factory-applied finish; notify Architect of damaged materials, and confirm acceptable process prior to completion of this work.

G. Sand work smooth and set exposed nails and screws.

H. Prepare for site finishing specified in Section 09 91 13.

3.4 TOLERANCES

A. Maximum Variation From Plumb and Level: 1/4 inch per 10 feet.

B. Maximum Offset From Joint Alignment: 1/16 inch.

END OF SECTION 07 46 23
SECTION 07 54 23 - THERMOPLASTIC-POLYOLEFIN ROOFING (TPO)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Thermoplastic membrane roofing system, including all components specified.

B. Commencement of work by Contractor shall constitute acknowledgement by Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing membrane manufacturer.

1.2 REFERENCE STANDARDS


G. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.


1.3 SUBMITTALS

A. Product Data:
   1. Provide membrane manufacturer's printed data sufficient to show that all components of roofing system, including insulation and fasteners, comply with the specified requirements and with the membrane manufacturer's requirements and recommendations for the system type specified; include data for each product used in conjunction with roofing membrane.

B. Samples: Submit samples of each product to be used.
   1. Sample of roof membrane.
   2. Sample of walkway pads.

C. Shop Drawings: Provide:
   1. The roof membrane manufacturer's standard details customized for this project for all relevant conditions, including flashings, base tie-ins, roof edges, terminations, expansion joints, penetrations, and drains.
   2. For tapered insulation, provide project-specific layout and dimensions for each board.

D. Specimen Warranty: Submit prior to starting work.

E. Installer Qualifications: Letter from manufacturer attesting that the roofing installer meets the specified qualifications.

F. Pre-Installation Notice: Copy to show that manufacturer's required Pre Installation Notice (PIN) has been accepted and approved by the manufacturer.

G. Executed Warranty.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Roofing installer shall have the following:
   1. Current approval, license, or authorization as applicator by the manufacturer.
   2. At least five years’ experience in installing specified system.
   3. Capability to provide payment and performance bond to building owner.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.

B. Store materials clear of ground and moisture with weather protective covering.
C. Keep combustible materials away from ignition sources.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.

C. Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.

D. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 years.
   2. For repair and replacement include costs of both material and labor in warranty.
   3. Include accidental punctures according to the manufacturer's standard warranty terms.
   4. Include hail damage according to the manufacturer's standard warranty terms.
   5. Exceptions NOT Permitted.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Roofing System:
   1. Firestone Building Products, LLC; Ultra Ply: www.firestonebpc.com
   4. Or approved equal.

B. Manufacturer of Insulation and Cover Boards: Same manufacturer as roof membrane.

C. Manufacturer of Metal Roof Edging: Same manufacturer as roof membrane.
   1. Metal roof edging products by other manufacturers are not acceptable.
   2. Field- or shop-fabricated metal roof edgings are not acceptable.

2.2 ROOFING SYSTEM DESCRIPTION

A. Roofing System: Thermoplastic polyolefin (TPO) single-ply membrane.
   1. Membrane Attachment: Fully adhered.
   2. Comply with applicable local building code requirements.

B. Roofing System Components: Listed in order from the top of the roof down:
1. Membrane: Thickness 0.080 inch, minimum. Factory fabricated into largest sheets possible.
2. Base Sheet Over Insulation: Mechanically attached.
3. Insulation Cover Board: High density polyisocyanurate; mechanically attached.
4. Insulation:
   a. Maximum Board Thickness: 2 inches; use as many layers as necessary; stagger joints in adjacent layers.
   b. Tapered: Slope as indicated; provide minimum R-value at thinnest point; place tapered layer on bottom.
   c. Total R-value of 30, minimum.
   d. Top Layer: Polyisocyanurate foam board, non-composite; mechanically fastened.
   e. Intermediate Layer(s), If Any: Polyisocyanurate foam board, non-composite; loose-laid, no attachment.
   f. Bottom Layer: Polyisocyanurate foam board, non-composite; mechanically fastened.
   g. Crickets: Tapered insulation of same type as specified for top layer; slope as indicated.
5. Vapor Retarder (Keynote: 075423-R): Material approved by roof manufacturer complying with requirements of fire rating classification; compatible with roofing and insulation materials.
   a. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
   b. Fire-retardant adhesive.
   c. Self-adhered installed to be air tight.
6. Deck Cover Board: Gypsum-based board, 1/2 inch thick; loose-laid, no attachment.

2.3 MEMBRANE MATERIALS

A. Membrane (Keynote: 075423-A): Flexible, heat weldable sheet composed of thermoplastic polyolefin polymer and ethylene propylene rubber; complying with ASTM D6878/D6878M, with polyester weft inserted reinforcement and the following additional characteristics:
   1. Thickness: 0.080 inch plus/minus 10 percent, with coating thickness over reinforcement of 0.030 inch plus/minus 10 percent.
   2. Puncture Resistance: 265 lbf, minimum, when tested in accordance FTM 101C Method 2031.
   3. Solar Reflectance: 0.79, minimum, when tested in accordance with ASTM C1549.

B. Slip Sheet: Coated glass fiber mat; qualified as part of Class A assembly over combustible and non-combustible decks, complying with ASTM D828 tensile testing.
C. Membrane Fasteners (Keynote: 075423-L): Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.

D. Curb and Parapet Flashing: Same material as membrane, with encapsulated edge which eliminates need for seam sealing the flashing-to-roof splice; precut to 18 inches wide.

E. Formable Flashing: Non-reinforced, flexible, heat weldable sheet, composed of thermoplastic polyolefin polymer and ethylene propylene rubber.
   1. Thickness: 0.060 inch plus/minus 10 percent.
   2. Tensile Strength: 1550 psi, minimum, when tested in accordance with ASTM D638 after heat aging.
   3. Elongation at Break: 650 percent, minimum, when tested in accordance with ASTM D638 after heat aging.
   4. Tearing Strength: 12 lbf, minimum, when tested in accordance with ASTM D1004 after heat aging.

F. Tape Flashing: 5-1/2 inch nominal wide TPO membrane laminated to cured rubber polymer seaming tape, overall thickness 0.065 inch nominal.

G. Bonding Adhesive: Neoprene and SBR rubber blend, formulated for compatibility with the membrane other substrate materials, including masonry, wood, and insulation facings.

H. Pourable Sealer: Two-part polyurethane, two-color for reliable mixing.

I. Seam Plates: Steel with barbs and Galvalume coating; corrosion-resistance complying with FM 4470.

J. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches wide by 0.10 inch thick.

K. Cut Edge Sealant: Synthetic rubber-based, for use where membrane reinforcement is exposed.

L. General Purpose Sealant: EPDM-based, one part, white general purpose sealant.

M. Molded Flashing Accessories: Unreinforced TPO membrane pre-molded to suit a variety of flashing details, including pipe boots, inside corners, outside corners, etc.

N. Roof Walkway Pads: Non-reinforced TPO walkway pads, 0.130 inch by 30 inches by 40 feet long with patterned traffic bearing surface.
2.4 ROOF INSULATION AND COVER BOARDS

A. Polyisocyanurate Board Insulation (Keynote: 075423-E): Closed cell polyisocynurate foam with black glass reinforced mat laminated to faces, complying with ASTM C1289 Type II Class 1, with the following additional characteristics:
1. Thickness: As indicated elsewhere.
2. Size: 48 inches by 96 inches, nominal.
   a. Exception: Insulation to be attached using adhesive or asphalt may be no larger than 48 inches by 48 inches, nominal.
3. R-value (LTTR):
   a. 6 inch Thickness: 30.0, minimum.
4. Compressive Strength: 20 psi when tested in accordance with ASTM C1289.
5. Ozone Depletion Potential: Zero; made without CFC or HCFC blowing agents.

B. High Density Polyisocyanurate Cover Board (Keynote: 075423-B): Non-combustible, water resistant, high density closed cell polyisocynurate core with coated glass mat facers, with the following characteristics:
1. Size: 48 inches by 96 inches, nominal.
2. Thickness: 1/2 inch.
3. Thermal Value: R-value of 2.5, when tested in accordance with ASTM C518 and ASTM C177.
4. Surface Water Absorption: 3 percent, maximum, when tested in accordance with ASTM C209.
5. Compressive Strength: 120 psi, when tested in accordance with ASTM D1621.
6. Density: 5 pcf, when tested in accordance with ASTM D1622/D1622M.
7. Factory Mutual approved for use with FM 1-60 and 1-90 rated roofing assemblies.

C. Insulation Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.

2.5 METAL ACCESSORIES

A. Parapet Copings: Formed metal coping with galvanized steel anchor/support cleats for capping any parapet wall; watertight, maintenance free, without exposed fasteners; butt type joints with concealed splice plates; mechanically fastened as indicated; Firestone PTCF.
1. Wind Performance:
   a. At least minimum required when tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3.
   b. Provide product listed in FM (AG) with at least FM 1-90 rating.
2. Description: Coping sections allowed to expand and contract freely while locked in place on anchor cleats by mechanical pressure from hardened stainless steel springs factory attached to anchor cleats; 8 inch wide splice plates with factory applied dual non-curing sealant strips capable of providing watertight seal.
3. Material and Finish: 0.040 inch thick formed aluminum, clear anodized finish; matching concealed joint splice plates; factory-installed protective plastic film.

4. Dimensions:
   a. Wall Width: As indicated on the drawings.
   b. Piece Length: Minimum 144 inches.
   c. Curved Application: Factory fabricated in true radius.

5. Anchor/Support Cleats: 20 gage, 0.036 inch thick prepunched galvanized cleat with 12 inch wide stainless steel spring mechanically locked to cleat at 72 inches on center.

6. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, corners, intersections, curves, pier caps, and end caps; minimum 14 inch long legs on corner, intersection, and end pieces.

7. Fasteners: Factory-furnished; electrolytically compatible; minimum pull out resistance of 240 pounds for actual substrate used; no exposed fasteners.

PART 3 INSTALLATION

3.1 GENERAL

A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.

B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.

C. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.

D. Perform work using competent and properly equipped personnel.

E. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.

F. Install roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F.

G. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.

H. Until ready for use, keep materials in their original containers as labeled by the manufacturer.

I. Consult membrane manufacturer's instructions, container labels, and Material Safety Data Sheets (MSDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

3.2 EXAMINATION

A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.

B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.

C. Examine roof substrate to verify that it is properly sloped to drains.

D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptable of project conditions and requirements.

3.3 PREPARATION

A. Take appropriate measures to ensure that fumes from adhesive solvents are not drawn into the building through air intakes.

B. Prior to proceeding, prepare roof surface so that it is clean, dry, and smooth, and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease and other materials that may damage the membrane.

C. Fill all surface voids in the immediate substrate that are greater than 1/4 inch wide with fill material acceptable insulation to membrane manufacturer.

D. Seal, grout, or tape deck joints, where needed, to prevent bitumen seepage into building.

3.4 VAPOR RETARDER

A. Before installing insulation install vapor retarder directly over the deck.
B. Ensure that all penetrations and edge conditions are sealed to prevent moisture and air drive into the roofing system.

3.5 INSULATION AND COVER BOARD INSTALLATION

A. Install insulation in configuration and with attachment method(s) specified in PART 2, under Roofing System.

B. Install insulation in a manner that will not compromise the vapor retarder integrity.

C. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.

D. Lay roof insulation in courses parallel to roof edges.

E. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch. Fill gaps greater than 1/4 inch with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch.

F. Mechanical Fastening: Using specified fasteners and insulation plates engage fasteners through insulation into deck to depth and in pattern required by membrane manufacturer.

3.6 SINGLE-PLY MEMBRANE INSTALLATION

A. Beginning at low point of roof, place membrane without stretching over substrate and allow to relax at least 30 minutes before attachment or splicing; in colder weather allow for longer relax time.

B. Lay out the membrane pieces so that field and flashing splices are installed to shed water.

C. Install membrane without wrinkles and without gaps or fish mouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.

D. Install membrane adhered to the substrate, with edge securement as specified.

E. Adhered Membrane: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.

F. Edge Securement: Secure membrane at all locations where membrane terminates or goes through an angle change greater than 2 in 12 inches using mechanically fastened reinforced perimeter fastening strips, plates, or metal edging as indicated or as recommended by roofing manufacturer.
   1. Exceptions: Round pipe penetrations less than 18 inches in diameter and square penetrations less than 4 inches square.
2. Metal edging is not merely decorative; ensure anchorage of membrane as intended by roofing manufacturer.

3.7 FLASHING AND ACCESSORIES INSTALLATION

A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.

B. Metal Accessories: Install metal edgings, gravel stops, and copings in locations indicated on the drawings, with horizontal leg of edge member over membrane and flashing over metal onto membrane.
   1. Follow roofing manufacturer's instructions.
   2. Remove protective plastic surface film immediately before installation.
   3. Install water block sealant under the membrane anchorage leg.
   4. Flash with manufacturer's recommended flashing sheet unless otherwise indicated.
   5. Where single application of flashing will not completely cover the metal flange, install additional piece of flashing to cover the metal edge.

C. Roofing Expansion Joints: Install as shown on drawings and as recommended by roofing manufacturer.

D. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces that the roofing membrane abuts to; extend flashing at least 8 inches high above membrane surface.
   1. Use the longest practical flashing pieces.
   2. Evaluate the substrate and overlay and adjust installation procedure in accordance with membrane manufacturer's recommendations.
   3. Complete the splice between flashing and the main roof sheet with specified splice adhesive before adhering flashing to the vertical surface.
   4. Provide termination directly to the vertical substrate as shown on roof drawings.

E. Roof Drains (Primary and Overflow):
   1. Taper insulation around drains to provide smooth transition from roof surface to drains. Use specified pre-manufactured tapered insulation with facer or suitable bonding surface to achieve slope; slope not to exceed manufacturer's recommendations.
   2. Position membrane, then cut a hole for roof drain to allow 1/2 to 3/4 inch of membrane to extend inside clamping ring past drain bolts.
   3. Make round holes in membrane to align with clamping bolts; do not cut membrane back to bolt holes.
   4. Apply sealant on top of drain bowl where clamping ring seats below the membrane.
   5. Install roof drain clamping ring and clamping bolts; tighten clamping bolts to achieve constant compression.
F. Flashing at Penetrations: Flash all penetrations passing through the membrane; make flashing seals directly to the penetration.

1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical; otherwise use specified self-curing elastomeric flashing.

2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches deep, with at least 1 inch clearance from penetration, sloped to shed water.

3. Structural Steel Tubing: If corner radii are greater than 1/4 inch and longest side of tube does not exceed 12 inches, flash as for pipes; otherwise, provide a standard curb with flashing.

4. Flexible and Moving Penetrations: Provide weather tight gooseneck set in sealant and secured to deck, flashed as recommended by manufacturer.

5. High Temperature Surfaces: Where the in-service temperature is, or is expected to be, in excess of 180 degrees F, protect the elastomeric components from direct contact with the hot surfaces using an intermediate insulated sleeve as flashing substrate as recommended by membrane manufacturer.

3.8 FINISHING AND WALKWAY INSTALLATION

A. Install walkways at access points to the roof, around rooftop equipment that may require maintenance, and where indicated on the drawings.

B. Walkway Pads: Adhere to the roofing membrane, spacing each pad at minimum of 1.0 inch and maximum of 3.0 inches from each other to allow for drainage.

   1. If installation of walkway pads over field fabricated splices or within 6 inches of a splice edge cannot be avoided, adhere another layer of flashing over the splice and extending beyond the walkway pad a minimum of 6 inches on either side.

   2. Prime the membrane, remove the release paper on the pad, press in place, and walk on pad to ensure proper adhesion.

3.9 FIELD QUALITY CONTROL

A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).

B. Perform all corrections necessary for issuance of warranty.

3.10 CLEANING

A. Clean all contaminants generated by roofing work from building and surrounding areas, including bitumen, adhesives, sealants, and coatings.

B. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.
C. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

3.11 PROTECTION

A. Where construction traffic must continue over finished roof membrane, provide durable protection and replace or repair damaged roofing to original condition.

END OF SECTION 07 54 23
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Fabricated sheet metal items, including brake metal, copings, flashings, counter flashings, and metal trim.

B. Sealants for joints within sheet metal fabrications.

C. Flashing for roof drains and roof penetrations.

1.2  REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.


1.3  ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.4  SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Samples for Initial Selection: Submit two samples 4 inch x 4 inch minimum in size illustrating metal color for each material and color.
1.5 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) requirements and standard
details, except as otherwise indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation.
Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Pre-Finished Aluminum: ASTM B209 (ASTM B209M) 16 gage, .050 inch thick unless
otherwise noted; plain finish shop pre-coated with fluoropolymer coating.
1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604;
multiple coat, thermally cured fluoropolymer finish system.
2. Color: As selected by Architect from manufacturer's standard colors.

2.2 METAL FLASHING APPLICATIONS

A. Coping (076200-C)
   1. Material: Pre-Finished Aluminum
   2. Thickness: .050 inch
   3. Color: As selected by Architect

B. Flashing (076200-D)
   1. Material: Pre-Finished Aluminum
   2. Color: As selected by Architect

2.3 FABRICATION - GENERAL

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints,
use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity,
seal with sealant.
2.4 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Seal or solder metal joints watertight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with clean water.

END OF SECTION 07 62 00
(THIS PAGE INTENTIONALLY LEFT BLANK)
SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Curbs.

B. Roof penetrations mounting curbs.

C. Roof hatches.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

B. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

C. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
   3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.4 WARRANTY

A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements

B. Correct defective Work within a five year period after Date of Substantial Completion.
PART 2  PRODUCTS

2.1 ROOF CURBS

A. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflushing with top and edges formed to shed water.

1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings.
2. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation.
3. Sheet Metal Material:
   a. Aluminum: 0.080 inch minimum thickness, with 3003 alloy, and H14 temper.
      1) Finish: Clear anodized.
4. Provide layouts and configurations indicated on drawings.

2.2 ROOF HATCHES

A. Roof Hatch Manufacturers:
   5. Or approved equal.

B. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gage, 0.0907 inch thick.
   2. Insulation: Manufacturer's standard; 2 inches rigid polyisocyanurate, located on outside face of curb.
   3. Curb Height: 12 inches from surface of roof deck, minimum.

C. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Mill finished aluminum; outer cover 11 gage, 0.0907 inch thick, liner 0.04 inch thick.
   3. Insulation: Manufacturer's standard 2 inches rigid polyisocyanurate.

D. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
2. Hinges: Manufacturer’s standard type.
3. Hold open arm with vinyl-coated handle for manual release.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. 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. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 72 00
SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.
B. Self-leveling pourable joint sealants.
C. Joint backings and accessories.

1.2 REFERENCE STANDARDS

K. SCAQMD 1168 - Adhesive and Sealant Applications.

1.3 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
2. List of backing materials approved for use with the specific product.
3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
4. Substrates the product should not be used on.
5. Substrates for which use of primer is required.
6. Substrates for which laboratory adhesion and/or compatibility testing is required.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, VOC content, and recommended tools.

C. Color Cards for Preliminary Selection: Where sealant color is not specified, submit manufacturer's color cards showing full range of colors available for selection. Architect may select up to three colors for final selection at each condition.

D. Field Samples for Verification: Provide a maximum of three color samples for each condition requiring color selection (up to 6 locations selected by Architect), including custom colors, installed in-situ, 12 inches in length, to be reviewed by Architect for final color selection.

E. Preconstruction Laboratory Test Reports: Submit with Product Data.

F. Joint Sealant Schedule: Include the following information:
   1. Joint sealant substrate application, joint location, and designation.
   2. Joint sealant manufacturer and product name.
   3. Joint sealant primer and backer.
   4. Joint sealant color.
   5. Any special conditions.

G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

H. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

I. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience and approved by manufacturer.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

D. Preconstruction Laboratory Testing:
   3. Stain Testing: In accordance with ASTM C1248; required only for porous substrates.
   4. Provide data showing previous testing on each combination of sealant, substrate, backing and accessories used on this Project, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
      a. If a substrate used on the Project has not been tested within the last 24 months, arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories. Allow sufficient time for testing to avoid delaying the work, and deliver sufficient samples to manufacturer for testing. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

E. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.
   2. Destructive field adhesion testing of sealant joints, except interior sealant joints.
      a. For each different sealant and substrate combination, allow for one test every 1000 linear feet (305 meters).
      b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
   3. Field testing agency's qualifications.
   4. Field Quality Control Log Form: Show same data fields as on Joint Sealant Schedule, adding date of installation of field sample to be tested and date of test, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

F. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
   4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.

6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.

7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

G. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inch long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.
   4. Record results on Field Quality Control Log.
   5. Repair failed portions of joints.

1.5 WARRANTY

A. Correct defective work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
   1. Provide 20-year warranty for silicones; minimum 10-year warranty for urethanes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   6. Or approved equal.
B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
   6. Or approved equal.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items:
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items:
      a. Joints between door, window, and other frames and adjacent construction.
      b. Other joints indicated below.
   3. Do not seal the following types of joints:
      a. Intentional weep holes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.

B. Exterior Joints: Use nonsag non-staining silicone sealant, unless otherwise indicated.
   1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
   2. Control and Expansion Joints in Concrete Paving: Self-leveling or Nonsag polyurethane "traffic-grade" sealant.
   3. Concealed, non-dynamic "bedding" joints, such as door thresholds: Butyl rubber, non-curing

C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
   2. Floor Joints in Wet Areas: Nonsag or Self-leveling polyurethane "traffic-grade" sealant suitable for continuous liquid immersion.
3. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant.
4. Narrow Control Joints in Interior Exposed Concrete Slabs: Self-leveling epoxy sealant.

2.3 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Non-Staining To Porous Materials: Non-staining to porous materials when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Custom Color: To be selected by Architect from manufacturer's full custom range.
   5. Cure Type: Single-component, neutral moisture curing.

B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multicomponent; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Hardness Range: 25 to 35, Shore A, when tested in accordance with ASTM C661.
   3. Custom Color: To be selected by Architect from manufacturer's full custom range.

C. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

2.4 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
   2. Hardness Range: 25 to 35, Shore A, when tested in accordance with ASTM C661.
   3. Color: To be selected by Architect from manufacturer's full range.

B. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Composition: Single or multicomponent, 100 percent solids by weight.
   2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
   3. Custom Color: To be selected by Architect.
2.5 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed Cell Polyethylene.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   3. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
   3. Record each test on Preinstallation Adhesion Test Log as indicated.
   4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
   5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.
3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.3 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.4 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
C. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION 07 92 00
(THIS PAGE INTENTIONALLY LEFT BLANK)
SECTION 08 16 13 - FIBERGLASS DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fiberglass doors.

B. Fiberglass door frames.

1.2 REFERENCE STANDARDS


B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors.

C. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.


H. ICC (IBC) - International Building Code.

I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's standard details, installation instructions, hardware and anchor recommendations.

B. Shop Drawings: Indicate layout and profiles; include assembly methods.
  1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
2. Indicate wall conditions, door and frame elevations, sections, materials, gages, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on drawings to identify details and openings.

C. Selection Samples: Submit two complete sets of color chips, illustrating manufacturer's available finishes, colors, and textures.

D. Test Reports: Submit certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer, include detailed terms of warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Mark doors with door opening mark number, door type, color, and weight.

B. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
   1. Store at temperature and humidity conditions recommended by manufacturer.
   2. Do not use non-vented plastic or canvas shelters.
   3. Immediately remove wet wrappers.

D. Store in position recommended by manufacturer, elevated minimum 4 inch above grade, with minimum 1/4 inch space between doors.

1.6 FIELD CONDITIONS

A. Do not install doors until structure is enclosed.

B. Maintain temperature and humidity at manufacturer's recommended levels during and after installation of doors.
1.7 WARRANTY

A. Provide ten (10) year manufacturer warranty covering materials and workmanship, including degradation or failure due to chemical contact.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Molded Fiberglass Doors:
   3. Or approved equal.

B. Fire-Rated Fiberglass Doors and Frames:
   3. Or Approved Equal

2.2 DOOR AND FRAME ASSEMBLIES

A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
   1. Physical Endurance: Swinging door cycle test to ANSI/SDI A250.4, Level A (1,000,000 cycles) minimum; tested with hardware and fasteners intended for use on project.
   2. Screw-Holding Capacity: Tested to 890 lbs., minimum.
   3. Surface Burning Characteristics: Flame spread index (FSI) of 0 to 25, Class A, and smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84.
   4. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
   5. Chemical Resistance: Resist degradation due to exposure to tap water and distilled water.
      a. Sewage and moisture-laden air.
   6. Provide products that meet USDA requirements for incidental food contact.
   7. Sizes: As indicated on drawings.
   10. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4 inch clearance to threshold.
   11. Provide frame anchors that allow for variation in rough opening size; field cutting of doors or frames to fit is not permitted.

B. Fire-Rated Doors and Frames: Comply with fire-ratings as indicated on drawings.
   1. Tested in accordance with ICC (IBC) for positive pressure or UL 10C.
   2. ITS (DIR) or UL (DIR) listed and labeled.
3. Visible seals when doors are open or closed is not permitted.

2.3 COMPONENTS

A. Doors: Fiberglass construction with reinforced core.
   2. Core Material: Manufacturer's standard core material for application indicated.
   3. Construction:
      a. Molded in one piece including through color gel coating on each side; manufacturer's standard subframe, core and faces fused during curing; hardware reinforcements.
   4. Face Sheet Texture: Smooth.
   5. Door Panel: Flush door.
   7. Waterproof Integrity: Provide factory fabricated edges, cut-outs, and hardware preparations of fiberglass reinforced plastic (FRP); provide cut-outs with joints sealed independently of glazing, louver inserts, or trim.
   8. Hardware Preparations: Factory reinforce, machine, and prepare for door hardware including field installed items; provide solid blocking for each item; field cutting, drilling or tapping is not permitted; obtain manufacturer's hardware templates for preparation as necessary.
   9. Bottom Rail: Provide height necessary to allow up to 1-1/4 inch field cut off bottom of door without impairing door strength or durability.

B. Door Frames: Provide type in compliance with performance requirements specified for doors.
   1. Type: Factory assembled with chemically welded joints.
   2. Profiles: As indicated on drawings.
   3. Color: Dark Brown, Std. 23 or approved equal.
   4. Fire-Rated: Provide frames bearing labels to match doors.
      a. Fiberglass reinforced plastic (FRP) with gel-coating matching doors.
   5. Corner Joints: Mitered with concealed corner blocks or angles of same material as frame; fiberglass and aluminum joined with screws; steel and stainless steel spot welded; sealed watertight with silicone sealant.
   6. Hardware Cut-outs: Provide continuous backing or mortar guards of same material as frame, with watertight seal.
   7. Frame Anchors: Stainless steel, Type 304; provide three anchors in each jamb for heights up to 84 inches with one additional anchor for each additional 24 inches in height.
   8. Reinforcing: Provide manufacturer's standard reinforcing at hinge, strike, and closer locations.

2.4 PERFORMANCE REQUIREMENTS

A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.
B. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 7.5 psf.

C. Air Leakage: Maximum of 0.1 cu ft/min/sq. ft at 6.27 psf differential pressure, when tested in accordance with ASTM E283.

D. Thermal Transmittance, Exterior Doors: AAMA 1503, U-value of 0.77, maximum, measured on exterior door in size required for this project.

2.5 FINISHES

A. Gel Coating: Ultraviolet (UV) stabilized polyester finish.
   1. Thickness: Minimum 15 mils wet thickness, plus/minus 3 mils.
   2. Color: Camel Tan, Std 5, or approved equal.

2.6 ACCESSORIES

A. Stops for Glazing: Fiberglass, unless otherwise indicated or required by fire rating; provided by door manufacturer to fit factory made openings, with color and texture to match door; fasteners shall maintain waterproof integrity.
   2. Fire-Rated Doors: Provide stop kit listed by labeling authority.
   3. Opening Sizes and Shapes: As indicated on drawings.

B. Glazing: As specified in Section 08 80 00.

C. Door Window Frames: Door window frames with glazing securely fastened within door opening.
   1. Size: 10 inches wide by 10 inches high.
   2. Frame Material: 18 gage, 0.0478 inch, galvanized steel.

D. Door Hardware: As specified in Section 08 71 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.

B. Do not begin installation until substrates have been properly prepared.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
B. Clean and prepare substrate in accordance with manufacturer's directions.

C. Protect adjacent work and finish surfaces from damage during installation.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.

B. Install fire-rated assemblies in accordance with NFPA 80.

C. Install exterior doors in accordance with ASTM E2112.

D. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.

E. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.

F. Repair or replace damaged installed products.

3.4 ADJUSTING

A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.

B. Adjust hardware for smooth and quiet operation.

C. Adjust doors to fit snugly and close without sticking or binding.

3.5 CLEANING

A. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance.

3.6 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 16 13
SECTION 08 54 13 - FIBERGLASS WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Factory fabricated fiberglass windows with fixed sash.

B. Glazed by factory; including infill panels.

1.2 REFERENCE STANDARDS


1.3 SUBMITTALS

A. Product Data: Provide component dimensions, anchors, fasteners, glass, and internal drainage details.

B. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related work, installation requirements.

C. Samples: Submit two ________, 4 x 4 inch in size, illustrating finished surfaces.

D. Manufacturer's Certificate: Certify that products of this section meet or exceed specified requirements.

E. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:

1. Evidence of AAMA Certification.
2. Evidence of WDMA Certification.
3. Evidence of CSA Certification.
4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

F. Installer's Qualification Statement.
G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

B. Jig, brace, and box the window frame assemblies for transport to minimize flexing of members or joints.

1.6 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and after installation of sealants.

1.7 WARRANTY

A. Correct defective Work within a ten year period after Date of Substantial Completion.

B. Provide ten year manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same. Include coverage for degradation of color finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fiberglass Windows:
   3. Or approved equal.

2.2 WINDOW UNITS

A. Fiberglass Windows: Hollow, tubular, multi-layer fiber reinforced material; factory fabricated; with vision glass, related flashings, anchorage and attachment devices.
   1. Configuration: As indicated on drawings.
3. Color: CHEM-PRUF 'DARK BROWN Std. 23' Or Approved Equal.
4. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Thermal Movement: Design to accommodate thermal movement caused by 100 degrees F temperature change without buckling stress on glass, joint seal failure, damaging loads on structural elements, damaging loads on fasteners, reduction in performance or other detrimental effects.

2.3 PERFORMANCE REQUIREMENTS

A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
   1. Performance Class (PC): R.

B. Overall Thermal Transmittance (U-value): 0.38, maximum, including glazing, measured on window sizes required for this project.

C. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 12.11 pounds per square foot.

D. Acoustic Performance: Minimum outdoor-indoor transmission class (OITC) rating of 34, when tested in accordance with ASTM E90 and ASTM E1332.

2.4 COMPONENTS

A. Frames: 3 1/4 inch wide by 1 3/4 inch deep profile; flush glass stops of screw fastened type.
   1. Window Type: A
   2. Type: Flush Flange.
   3. Frame Corners: Mitered and joined with nylon corner locks.

B. Frames: 3 3/4 inch wide by 1 3/4 inch deep profile; flush glass stops of screw fastened type.
   1. Window Type: B
   2. Type: Flush Flange.
   3. Frame Corners: Mitered and joined with nylon corner locks.

C. Mullion: 3 1/4 inch wide by 3 1/2 inch deep profile.
   1. Window Type: A

D. Fasteners: Stainless steel.

E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.
1. Refer to Section 07 92 00 for additional requirements.

2.5 GLASS AND GLAZING MATERIALS

   A. Glass and Glazing Materials: As specified in Section 08 80 00.

2.6 FABRICATION

   A. Fabricate framing, mullions and sash members with fusion welded corners and joints, in a rigid jig. Supplement frame sections with internal reinforcement where required for structural rigidity.

   B. Form sills in one piece. Slope sills for wash.

   C. Form snap-in glass stops, closure molds, weather stops, and flashings for tight fit into window frame section.

   D. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

   E. Arrange fasteners to be concealed from view.

   F. Permit internal drainage weep holes and channels to migrate moisture to exterior. Provide internal drainage of glazing spaces to exterior through weep holes.

   G. Factory glaze window units.

PART 3 EXECUTION

3.1 EXAMINATION

   A. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

3.2 INSTALLATION

   A. Install windows in accordance with manufacturer's instructions.

   B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

   C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

   D. Set sill members and sill flashing in continuous bead of sealant.
E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Coordinate attachment and seal of perimeter air and vapor barrier materials.

G. Install glass in accordance with Section 08 80 00, to glazing method required to achieve performance criteria.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

B. Repair or replace fenestration components that have failed designated field testing, and retest to verify performance conforms to specified requirements.

3.4 ADJUSTING

A. Adjust for secure weathertight closure.

3.5 CLEANING

A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

B. Remove protective material from pre-finished surfaces.

C. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.

D. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

END OF SECTION 08 54 13
SECTION 08 71 00 - DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hardware for fiberglass doors.
B. Hardware for fire-rated fiberglass doors.
C. Thresholds.
D. Weatherstripping and gasketing.

1.2 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
B. BHMA A156.1 - American National Standard for Butts and Hinges.
C. BHMA A156.3 - American National Standard for Exit Devices.
D. BHMA A156.4 - American National Standard for Door Controls - Closers.
E. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks.
F. BHMA A156.6 - American National Standard for Architectural Door Trim.
G. BHMA A156.7 - American National Standard for Template Hinge Dimensions.
I. BHMA A156.16 - American National Standard for Auxiliary Hardware.
K. BHMA A156.18 - American National Standard for Materials and Finishes.
L. BHMA A156.21 - American National Standard for Thresholds.
N. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames.


P. ITS (DIR) - Directory of Listed Products.

Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.


S. UL (DIR) - Online Certifications Directory.

T. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

C. Keying Requirements Meeting:
   1. Attendance Required:
      a. Contractor.
      b. Owner.
      c. Architect.
   2. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
   3. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
   4. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
   5. Deliver established keying requirements to manufacturers.

1.4 SUBMITTALS

A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
B. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
   2. Provide complete description for each door listed.

C. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
   1. Submit manufacturer's parts lists and templates.

D. Keying Schedule: Submit for approval of the Owner.

E. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
   1. Lock Cylinders: Ten for each master keyed group.
   2. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.5 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.7 WARRANTY

A. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
   1. Closers: Ten years, minimum.
   2. Locksets and Cylinders: Three years, minimum.
   3. Other Hardware: Two years, minimum.
PART 2 PRODUCTS

2.1 DOOR HARDWARE - GENERAL

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes
   3. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   4. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
   5. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.

D. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. Refer to Door Hardware Schedule.

E. Finishes: Provide door hardware of the same finish unless otherwise indicated.
   2. Finish Definitions: BHMA A156.18
   3. Exceptions:
      a. Hinges for doors: Steel base metal with painted finished.
      b. Door Closer Covers and Arms: Color to be selected by Architect from manufacturer's standard colors.

2.2 LOCK AND LATCHES

A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
   1. Hardware Sets indicate locking functions required for each door.
   2. If no hardware set is indicated for a swinging door provide an office lockset.
   3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no lock trim.
   4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.

B. Lock Cylinders: Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
   1. Provide cams and/or tailpieces as required for locking devices required.
C. Keying: Grand master keyed.
   1. Include Construction keying.
   2. Key to existing system
   3. Supply keys in the following quantities:
      a. 1 Grand Master-keys
      b. 4 each Master-keys
      c. 2 each Change keys each keyed core
      d. 15 each Construction master-keys
      e. 1 each Control keys

2.3 Hinges

A. Manufacturers:
   1. McKinney; an Assa Abloy Group company; [Plain Bearing Hinges: Standard
   4. Or approved equal.

B. Hinges: Complying with BHMA A156.1, Grade 1.
   1. Butt Hinges: Complying with BHMA A156.1 and BHMA A156.7 for templated
      hinges.
      a. Provide hinge width required to clear surrounding trim.
   2. Provide hinges on every swinging door.
   3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   4. Provide ball-bearing hinges at each door with closer.
   5. Provide non-removable pins on exterior out swinging doors.
   6. Provide following quantity of butt hinges for each door:
      a. Doors From 60 inches High up to 90 inches High: Three hinges.

2.4 Automatic Flush Bolts

A. Manufacturers:
   1. Assa Abloy Rockwood 2840
   4. Or approved equal.

B. Automatic Flush Bolts: Comply with BHMA A156.16, Grade 1.
   2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into
      top of frame.
      a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as
         required to comply with code.
   3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.
4. Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.

2.5 MORTISE LOCKS

A. Manufacturers:
   4. Or approved equal.

B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
   1. Latch bolt Throw: 3/4 inch, minimum.
   2. Deadbolt Throw: 1 inch, minimum.
   4. Strikes: Provide manufacturer's standard strike for each latch set or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Flat-Lip Strikes: Provide for locks with three piece antifriction latch bolts as recommended by manufacturer.
      b. Finish: To match lock or latch.

2.6 COORDINATORS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company; Rockwood 1100: www.assaabloydss.com.
   3. Or approved equal.

B. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.
   1. Type: Bar, unless otherwise indicated.
   2. Material: Aluminum, unless otherwise indicated.
   3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.7 CLOSERS

A. Manufacturers; Surface Mounted:
   4. Or approved equal.
B. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide door closer on each exterior door.
   3. Provide door closer on each fire-rated door.
   4. At corridor entry doors, mount closer on room side of door.
   5. At out swinging exterior doors, mount closer on interior side of door.

2.8 CLOSER WITH DOOR HOLDER

A. Closer as listed above with integral hold open.
   1. Basis of Design: Assa Abloy Norton 1600 Parallel Arm with 1601 H.

2.9 ARMOR PLATES

A. Armor Plates: Provide on bottom half of push side of doors that require protection
   from objects moving through openings that may damage door surface.
   1. Size: 30 inch high by 1-1/2 inch less door width (LDW) on pull side and 2 inch
      LDW on push side of door.

2.10 KICK PLATES

A. Kick Plates: Provide along bottom edge of push side of every door with closer, unless
   otherwise indicated.
   1. Size: 12 inch high by 2 inch less door width (LDW) on push side of door.

2.11 WALL STOPS

A. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention
   Test as described in this standard.
   1. Type: Bumper, concave, wall stop.
   3. Provide a stop for every swinging door, unless otherwise indicated.
   4. If stops are not practical, due to configuration of room or furnishings, provide
      overhead stop.
   5. Stop is not required if positive stop feature is specified in closer; positive stop
      feature of door closer is not an acceptable substitute for a stop unless specifically
      so stated.

2.12 THRESHOLDS

A. Manufacturers:
   5. Or approved equal.
B. Thresholds: Comply with BHMA A156.21.
   1. Provide threshold at each exterior door.
   2. Type: Flat surface.
   4. Threshold Surface: Thermally broken at all exterior doors.
   5. Field cut threshold to profile of frame and width of door sill for tight fit.
   6. Provide non-corroding fasteners at exterior locations.

2.13 WEATHERSTRIPPING AND GASKETING

A. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Head and Jamb Type: Adjustable.
   2. Door Sweep Type: Encased in retainer.
   3. Material: Aluminum, with brush weatherstripping.
   4. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
   5. Provide door bottom sweep on each exterior door, unless otherwise indicated.

2.14 ANIMAL DART PORTS

A. Door manufacturer to install dart ports provided by caging manufacturer prior to installation of doors. See Section 05 59 64, for caging manufacturer information.
   1. Location: As indicated on drawings.
   2. Size: 4” x 4”
   3. Color: To Match/Painted Door Finish Selection.

2.15 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
   1. Primary Finish: 630; satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D); BHMA A156.18.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
C. Use templates provided by hardware item manufacturer.

D. Do not install surface mounted items until application of finishes to substrate are fully completed.

E. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
   1. Mounting heights in compliance with ADA Standards:

F. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 FIELD QUALITY CONTROL

   A. Perform field inspection and testing under provisions of Section 01 40 00 - Quality Requirements.

3.4 ADJUSTING

   A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.

   B. Adjust hardware for smooth operation.

   C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.5 CLEANING

   A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

   B. Clean adjacent surfaces soiled by hardware installation.

   C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.6 PROTECTION

   A. Protect finished Work under provisions of Section 01 7000.

   B. Do not permit adjacent work to damage hardware of finish.
3.7 HARDWARE SETS - GENERAL

A. Pair of Swinging Doors: Provide one of each of the specified item on each leaf unless specifically stated otherwise. Treat pairs as two active leaves unless otherwise indicated.

B. HW-CYL: Doors Whose Hardware is Specified in Other Sections But Which Must Be keys To Building System:
   1. Lock Cylinder, Mortise, keyed to building system.

3.8 SWINGING DOORS - NOT REQUIRING KEY LOCKING

A. HW-1: Privacy Lockset, Fire Rated
   1. Lockset, Privacy
   2. "In Use" Indicator
   3. Closer
   4. Kick plate

3.9 SWING DOORS - KEY REQUIRED TO LOCK, MAY BE LEFT UNLOCKED

A. HW-10: Classroom Lock, Fire-Rated
   1. Lockset, Classroom
   2. Closer
   3. Armor plate

B. HW-11: Classroom Lock, Fire-Rated
   1. Lockset, Classroom
   2. Closer
   3. Pair: One leaf inactive; automatic or self-closing flush bolts as required to comply with code. Door rating requires astragal, provide coordinator.
   4. Armor plate

C. HW-13: Classroom Lock, Non-Fire-Rated
   1. Lockset, Classroom.
   2. Armor plate.

D. HW-14: Classroom Lock, Non-Fire-Rated, Exterior
   1. Lockset, Classroom
   2. Closer
   3. Armor plate
   4. Threshold

3.10 SWINGING DOORS - MAY NOT BE LEFT UNLOCKED

A. HW-15: Storeroom Lock, Fire Rated
   1. Lockset, Storeroom
   2. Closer
3. Kick plate

B. HW-16: Storeroom Lock, Non-Fire-Rated
   1. Lockset, Storeroom
   2. Pair: One leaf inactive; automatic or self-closing flush bolts.

C. HW-20: Always-Locked, Non-Fire-Rated, Exterior
   1. Lockset, Always-Locked
   2. Closer with Door Holder
   3. Armor plate
   4. Threshold
   5. Pair: One leaf inactive; automatic or self-closing flush bolts.

D. HW-21: Always-Lock, Non-Fire-Rated, Exterior
   1. Lockset, Always-Locked.
   2. Closer
   4. Threshold

   1. Lockset, Always-Locked.
   2. Closer
   3. Exterior Out swinging door
   4. Pair: One leaf inactive; automatic or self-closing flush bolts.
   5. Kick plate
   6. Threshold

   1. Lockset, Storeroom, Locked from both sides of the door.
   2. Closer
   3. Kick plate
   4. Lockset, Always-Locked for the interior side. Free egress from the exterior to the interior for roof access.

END OF SECTION 08 71 00
(THIS PAGE INTENTIONALLY LEFT BLANK)
SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.
B. Glazing units.
C. Glazing compounds and accessories.

1.2 REFERENCE STANDARDS

M. GANA (GM) - GANA Glazing Manual.
N. GANA (SM) - GANA Sealant Manual.
P. ICC (IBC) - International Building Code.
R. ITS (DIR) - Directory of Listed Products.
S. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
T. NFRC 100 - Procedure for Determining Fenestration Product U-factors.
W. UL (DIR) - Online Certifications Directory.
X. UL 10B - Standard for Fire Tests of Door Assemblies.
Y. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
1.5 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.6 WARRANTY

A. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

B. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.
   2. To maintain a continuous vapor retarder and air barrier throughout the glazed assembly from glass pane to heel bead of glazing sealant.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.

2.2 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless noted otherwise.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
   2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
   4. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 test requirements for Category II.
   2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.

2.3 INSULATING GLASS UNITS

A. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Metal Edge Spacers: Aluminum, bent and soldered corners.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
   7. Purge interpane space with dry air, hermetically sealed.

B. Type GL-1 - Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Space between lites filled with argon.
   3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
      b. Coating: Low-E (passive type), on #2 surface.
   4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
   5. Total Thickness: 1 inch.
   6. Thermal Transmittance (U-Value): 0.38, maximum.

8. Solar Heat Gain Coefficient (SHGC): 0.36, maximum.

2.4 GLAZING UNITS

A. Type GL-2 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 45 minutes.
   1. Applications:
      a. Glazing in fire-rated door assembly.
      b. Glazing in fire-rated window assembly.
   2. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers.
   3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
   4. Safety Glazing Certification: 16 CFR 1201 Category II.
   5. Glazing Method: As required for fire rating.
   6. Fire-Rating Period: 60 minutes.
      a. "W" - meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
      b. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
   8. Manufacturers:
      a. GGI - General Glass International; Pyrobel: www.generalglass.com/#sle.
      b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL 60: www.safti.com/#sle.

2.5 GLAZING COMPOUNDS

A. Type GC-2 - Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

B. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; Black color.

C. Manufacturers:
2.6 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self-adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
   1. Width: As required for application.
   2. Thickness: As required for application.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

C. Verify that sealing between joints of glass framing members has been completed effectively.

3.2 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.
3.3 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, firesafing, plastering, mortar droppings, etc.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Interior Glazed:  Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.6 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.
3.7 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 80 00
SECTION 08 91 00 - LOUVERS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Louvers, frames, and accessories.

1.2  REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

B. AMCA 511 - Certified Ratings Program for Air Control Devices.

1.3  SUBMITTALS

A. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blank out areas required, and frames.

B. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.

C. Test Reports: Independent agency reports showing compliance with specified performance criteria.

1.4  QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

1.5  WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.

PART 2  PRODUCTS

2.1  MANUFACTURERS

A. Louvers:
4. Or Approved Equal.

2.2 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
   1. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
   2. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.

B. Stationary Louvers, Type L: Horizontal blade, extruded aluminum construction, with intermediate mullions matching frame.
   1. Free Area: 50 percent, minimum.
   2. Blades: Drainable.
   3. Frame: 6 inches deep, channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
   4. Aluminum Thickness: Frame 12 gage, 0.0808 inch minimum; blades 12 gage, 0.0808 inch minimum.
   5. Aluminum Finish: Class II color anodized; finish welded units after fabrication.

2.3 MATERIALS


2.4 FINISHES

A. Class II Color Anodized Finish: AAMA 611 AA-M12C22A32 Integrally colored anodic coating not less than 0.4 mils thick.

B. Primer: Zinc chromate, alkyd type.

C. Color: To Match Chem-Pruf 'Dark Brown Std. 23' Or Approved Equal.

2.5 ACCESSORIES

A. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.

B. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.
PART 3  EXECUTION

3.1  EXAMINATION

   A. Verify that prepared openings and flashings are ready to receive this work and opening
dimensions are as indicated on shop drawings.

   B. Verify that field measurements are as indicated.

3.2  INSTALLATION

   A. Install louver assembly in accordance with manufacturer's instructions.

   B. Install louver level and plumb.

   C. Align louver assembly to ensure moisture shed from flashings and diversion of
   moisture to exterior.

   D. Secure louver frames in openings with concealed fasteners.

   E. Coordinate with installation of mechanical ductwork.

3.3  CLEANING

   A. Strip protective finish coverings.

   B. Clean surfaces and components.

END OF SECTION 08 91 00
SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Metal channel ceiling framing.
D. Acoustic insulation.
E. Joint treatment and accessories.
F. Acoustic (sound-dampening) wall and ceiling board.

1.2 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute.
G. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.


N. UL (FRD) - Fire Resistance Directory.

1.3 SUBMITTALS

A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

B. Samples: Submit two samples of predecorated gypsum board, 12 by 12 inches in size, illustrating finish color and texture.

1.4 QUALITY ASSURANCE

A. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.2 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: "C" shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.

B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 40 00.
2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   4. Or approved equal.

B. Abuse Resistant Wallboard (Keynote: 092116-B):
   1. Application: Wall Types C.01 & C.02.
   2. Surface Abrasion:  Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Mold Resistance:  Score of 10, when tested in accordance with ASTM D3273.
   4. Paper-Faced Type:  Gypsum wallboard as defined in ASTM C1396/C1396M.
   5. Type:  Fire resistance rated Type X, UL or WH listed.
   8. Products:
      a. American Gypsum Company; M-Bloc AR Type X.
      b. Continental Building Products;  Rapid Deco Level 5 Type X with Protecta.
      c. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold Guard Abuse-Resistant.
      d. National Gypsum Company; Gold Bond Hi-Abuse XP Gypsum Board.
      e. Or approved equal.

C. Ceiling Board (Keynote: 092116-H): Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceiling Type 2.01, unless otherwise indicated.
   2. Thickness:  1/2 inch.
   4. Products:
      a. Continental Building Products; Sagcheck.
      b. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
      c. Or approved equal.

D. Exterior Sheathing Board:  As specified in Section 06 10 00.

E. Exterior Soffit Board (Keynote: 092116-I):  Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application:  Ceilings and soffits in protected exterior areas, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Rating:  Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
3. Types: Type X, in locations indicated.
4. Type X Thickness: 5/8 inch.
5. Regular Type Thickness: 1/2 inch.
7. Products:
   a. American Gypsum Company; Exterior Soffit Gypsum Wallboard Type X.
   b. Continental Building Products; Soffit board.
   c. Georgia-Pacific Gypsum; ToughRock Fireguard C Soffit Board.
   d. Or approved equal.

2.4 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 1/2 inch.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Water-Resistive Barrier: As specified in Section 07 25 00.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Chemical hardening type compound.

E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

G. Exterior Soffit Vents: One piece, perforated, ASTM B221 6063 T5 alloy aluminum, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide continuous vent.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.
3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/600.
   2. Laterally brace entire suspension system.
   3. Install bracing as required at exterior locations to resist wind uplift.

C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items with partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.4 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
   1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistant barrier.

C. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
   1. Seal joints, cut edges, and holes with water resistant sealant.

D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.
B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on drawings. Provide vent area specified.

3.6 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 3: Walls to receive textured wall finish.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.7 TEXTURE FINISH

A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

3.8 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 09 21 16
SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal partition, ceiling, and soffit framing.
B. Framing accessories.

1.2 SUBMITTALS

A. Shop Drawings: Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
B. Product Data: Provide data describing framing member materials and finish and product criteria.
C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.1 DESCRIPTION

2.2 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
1. Studs: C shaped with flat or formed webs with knurled faces.
2. Runners: U shaped, sized to match studs.
3. Furring: Z shaped, 12 ga, depth indicated on drawings.
5. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

B. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

C. Tracks and Runners: Same material and size as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
2.3 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that rough-in utilities are in proper location.

3.2 INSTALLATION OF STUD FRAMING

A. Extend partition framing to structure where indicated and to ceiling in other locations.

B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

C. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs as indicated.

D. Align and secure top and bottom runners at 24 inches on center.

E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

F. Align stud web openings horizontally.

G. Secure studs to tracks using crimping method. Do not weld.

H. Fabricate corners using a minimum of three studs.

I. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.

J. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

K. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.
3.3 CEILING AND SOFFIT FRAMING

A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

B. Install furring independent of walls, columns, and above-ceiling work.

C. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

3.4 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION 09 22 16
SECTION 09 22 36.23 - METAL LATH

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal lath for cement and gypsum plaster.
B. Non-metallic lath for cement plaster.
C. Furring for metal lath.

1.2 REFERENCE STANDARDS

D. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in thickness.
E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

1.3 SUBMITTALS

A. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

1.4 QUALITY ASSURANCE

A. Maintain one copy of each installation standard referenced on site throughout the duration of lathing and plastering work.
PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Lath and Accessories:

2.2 LATH

   1. Weight: To suit application and as specified in ASTM C841 or ASTM C1063 for framing spacing.
   2. Weight: 2.5 lb./sq. yd.
   3. Backed with treated paper.

B. Welded Wire Lath: ASTM C333; galvanized; with 2 inch square openings, paper strips woven into lath, of weight to suit application and as specified in ASTM C841 or ASTM C1063 for framing spacing.

C. Woven Wire Mesh: ASTM C1032; galvanized; with 1 inch hexagonal openings; self-furring, of weight to suit application and as specified in ASTM C841 or ASTM C1063 for framing spacing.

D. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; same finish as lath.

E. Strip Mesh: Expanded metal lath, same weight as lath, 2 inch wide by 24 inch long; same finish as lath.

F. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.
   1. Material: Formed sheet steel with rust inhibitive primer, expanded metal flanges.
      a. Products:
         1) Alabama Metal Industries Corporation; E-Z Bead:
            www.amicoglobal.com/#sle.
         2) Phillips Manufacturing Co; #66 Expanded Flange Square Casing Bead:
            www.phillipsmfg.com/#sle.
         3) Or approved equal.
   3. Corner Beads: Radiused corners.
a. Products:
   1) Phillips Manufacturing Co; #1 Expanded Corner Bead: www.phillipsmfg.com/#sle.
   3) Or approved equal.

2.3 ACCESSORIES

A. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.

B. Fasteners: Self-piercing tapping screws; ASTM C1002 or ASTM C954.

C. Tie Wire: Annealed galvanized steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that substrates are ready to receive work and conditions are suitable for application.

C. Do not begin until unacceptable conditions have been corrected.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION - GENERAL

A. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.

3.3 WALL FURRING INSTALLATION

A. Install furring channels horizontally; secure with fasteners on alternate channel flanges at maximum 24 inches on center.

B. Space furring channels maximum 16 inches on center, and not more than 4 inches away from floor and ceiling lines.

3.4 CONTROL JOINT INSTALLATION

A. Locate joints as indicated on drawings and comply with ASTM C1063.
B. Install expansion joints where an expansion joint occurs in base exterior wall.

C. Install prefabricated joint accessories in accordance with ASTM C1063.

3.5 LATH INSTALLATION

A. Apply lath taut, with long dimension perpendicular to supports.

B. Attach metal lath to concrete using wire loops. Attach anchors to backup surface; space at maximum 24 inches on center.

C. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement, fasten at perimeter edges only.

D. Place corner bead at external wall corners; fasten at outer edges of lath only.

E. Place base screeds at termination of plaster areas; secure rigidly in place.

F. Place 4 inch wide strips of lath centered over junctions of dissimilar backing materials, and secure rigidly in place.

G. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.

H. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

I. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

3.6 TOLERANCES

A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.

B. Maximum Variation from True Position: 1/8 inch.

END OF SECTION 09 36 23
SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

C. Supplementary acoustical insulation above ceiling.

1.2 REFERENCE STANDARDS


C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

A. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples 6x6 inch in size illustrating material and finish of acoustical units.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Acoustical Units: Quantity equal to 2 percent of total installed.
1.5 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 FIELD CONDITIONS

A. Maintain uniform temperature within range recommended by manufacturer, but not less 60 degrees F, with a maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acoustic Tiles/panels:
   4. Or approved equal.

B. Suspension Systems:
   1. Same as for acoustical units.

2.2 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panels - Ceiling Type 1.01: Painted fiberglass ASTM E1264 Type XII, Form 2, Pattern E, with the following characteristics:
   1. Size: 24 x 24 inches.
   2. Thickness: 3/4 inches.
   4. CAC: 37 min as determined by ASTM C1414.
   5. Light Reflectance: 88 percent, determined as specified in ASTM E1264.
   6. NRC Range: 0.90, determined as specified in ASTM E1264.
   8. Edge: Square.
   10. Surface Texture: Fine.
12. Suspension System: Exposed Steel Suspension System Type B.
13. Products: 3150 Optima Lay-In by Armstrong World Industries, Inc. or approved equal.

2.3 SUSPENSION SYSTEM(S)

A. Manufacturer: Same as for acoustical units.

B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

C. Exposed Steel Suspension System Type B: Formed steel, commercial quality, hot dipped galvanized steel; heavy-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   4. Locations: Use with Ceiling Type 1.01.
   5. Products:
      a. Prelude ML 15/16" Exposed Tee by Armstrong World Industries, Inc. or approved equal.

2.4 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
   2. At every outside corner bullnose in a CMU wall, provide a bullnose corner cover.

C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M and manufacturer's instructions and as supplemented in this section.
B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected ceiling plan.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

3.3 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.
   2. Double cut and field paint exposed reveal edges.

G. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.
3.4 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 51 00
SECTION 09 67 00 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-applied flooring and base.

1.2 REFERENCE STANDARDS


C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

D. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.3 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.

B. Samples: Submit two samples, 6 x 6 inch in size illustrating color and pattern for each floor material for each color specified.

1.4 MOCK UP

A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
   1. Number of Mock-Ups to Be Prepared: One.
   2. Use same materials and methods for use in the work.
   3. Location: Restroom #106.

B. Approved mock-up may remain as part of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resin materials in a dry, secure area.

B. Store materials for three days prior to installation in area of installation to achieve temperature stability.
1.6 FIELD CONDITIONS

A. Maintain minimum temperature in storage area of 55 degrees F.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

1.7 WARRANTY

A. Correct defective Work within a one year period after Date of Substantial Completion.

B. Warranty: Include coverage for bond to substrate and degradation of chemical resistance.

PART 2 PRODUCTS

2.1 FLUID-APPLIED FLOORING SYSTEMS

A. Fluid-Applied Flooring and Seamless Cove Base Type 1.02: Urethane, two component, thermosetting, colored with mineral filler, with aggregate broadcast on undercoat.
   1. Base Coat: 1/8 inch thick; color as selected by Architect from manufacturer's full range.
   2. Undercoat: Two component, high-solids epoxy bonding coat.
   3. Aggregate: Small quartz chips, TBD color.
   4. Top Coat: Urethane, two component, thermosetting; 1/16 inch thick; clear.
   5. System Thickness: 3/16 inch, nominal, when dry.
   6. Tensile Strength: 1,000 psi, when tested in accordance with ASTM D638.
   7. Compressive Strength: 5,000 psi after 7 days, when tested in accordance with ASTM D695.
   8. Abrasion Resistance: Maximum weight loss of .03 g/1000 cycles, when tested in accordance with ASTM D4060.

2.2 ACCESSORIES

A. Base Caps: Integral with projecting base of 1/8 inch; Silver Sage color.

B. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.

C. Primer: Type recommended by fluid-applied flooring manufacturer.
PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by flooring materials manufacturer.

3.2 PREPARATION

A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.

B. Prepare concrete surfaces according to ICRI 310.2R.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

3.3 INSTALLATION - ACCESSORIES

A. Install terminating cap strip at top of base; attach securely to wall substrate.

3.4 INSTALLATION - FLOORING

A. Apply in accordance with manufacturer's instructions.

B. Apply each coat to minimum thickness indicated.

C. Finish to smooth level surface.

D. Cove at vertical surfaces.

3.5 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

END OF SECTION 09 67 00
SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints and stains.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Wood board siding.
   2. Wood benches.
   3. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   4. Exposed surfaces of steel lintels and ledge angles.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Glass.
   9. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

A. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.


D. SSPC-SP 1 - Solvent Cleaning.

E. SSPC-SP 2 - Hand Tool Cleaning.

F. SSPC-SP 6 - Commercial Blast Cleaning.
G. SSPC-SP 13 - Surface Preparation of Concrete.

1.3 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

1.4 MOCK-UP

A. Locate where directed by Architect for wood stains only.

B. Mock-up may remain as part of the work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

B. Paints:
   4. Or approved equal.

C. Transparent Finishes:
   4. Or approved equal.

D. Stains:
   4. Or approved equal.

E. Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.
   2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.3 PAINT SYSTEMS - EXTERIOR

A. Paint E-TR-W - Stain on Wood:
   1. 2 coats stain.
   2. Stain: Exterior Semi-Transparent Stain for Wood, Water Based; MPI #156.
a. Products:
   1) Behr Premium Semi-Transparent Weatherproofing Wood Stain No. 5077 Tint Base.

B. Paint E-TR-C - Transparent Finish on Concrete Floors:
   1. 1 coat stain.
   2. Sealer: Water Based for Concrete Floors; MPI #99.
      a. Products:
         1) Behr Premium Wet-Look Sealer Low-Luster [No. 986]. (MPI #99)

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by
   manufacturer of top coats.
   1. Alkali Resistant Water Based Primer; MPI #3.
      a. Products:
         1) Behr Concrete and Masonry Bonding Primer [No. 880].
         2) PPG Paints Perma-Crete Interior/Exterior Alkali Resistant Primer, 4-603 Series. (MPI #3)
         3) Valspar Acrylic Alkali-Resistant Masonry Primer, No. 80165.
   2. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
      a. Products:
         1) PPG Paints Speed hide Interior/Exterior Rust Inhibitive Steel Primer, 6-212 Series. (MPI #79)
         2) PPG Devguard Multi-Purpose Primer, 4160 Series. (MPI #79)
         3) Pratt & Lambert Rust Inhibitive Metal Primer.
         4) Valspar Armor Anti-Rust Oil Metal Primer, No. 21852. (MPI #79)

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths,
   sanding materials, and clean-up materials as required for final completion of painted
   surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product
   manufacturer.
B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Plaster and Stucco: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
   4. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches. Allow to dry.
   3. Clean concrete according to ASTM D4258. Allow to dry.
   4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.


J. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

K. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

L. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

M. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.

N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

E. Sand wood and metal surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 91 13
SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. High performance coatings.
B. Surface preparation.

1.2 REFERENCE STANDARDS

E. SSPC-SP 1 - Solvent Cleaning.
F. SSPC-SP 2 - Hand Tool Cleaning.
G. SSPC-SP 6 - Commercial Blast Cleaning.
H. SSPC-SP 13 - Surface Preparation of Concrete.

1.3 SUBMITTALS

A. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47)
   3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
B. Samples: Submit two samples 8 by 8 inch in size illustrating colors available for selection.
C. Manufacturer's Certificate: Certify that high-performance coatings conform to VOC limits specified.
1.4 MOCK-UP

A. Provide mock-up of wall, one feet long by four feet wide, illustrating coating, for each specified coating.

B. Locate where directed.

C. Mock-up may remain as part of the work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

B. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.

C. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

D. Restrict traffic from area where coating is being applied or is curing.

1.7 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide high performance coating products from the same manufacturer to the greatest extent possible.

B. High-Performance Coatings: Provide products by one of the following manufacturers:

2.2 HIGH-PERFORMANCE COATINGS

A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
   3. Abrasion Resistance: 15 mg loss, when tested in accordance with ASTM D-4060.
   4. Impact Resistance: 45, when tested in accordance with ASTM 2794.
   5. Hardness: 75, when tested in accordance with ASTM D-2240, Shore D.
   6. Lead Content: None.

2.3 TOP COAT MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
   1. Volatile Organic Compound (VOC) Content:
      a. Provide coatings that comply with the most stringent requirements specified in the following:
            (a) Opaque, Flat: 50 g/L, maximum.
            (b) Opaque, Nonflat: 150 g/L, maximum.
            (c) Opaque, High Gloss: 250 g/L, maximum.
            (d) Varnishes: 350 g/L, maximum.
      b. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
   2. Colors: To Match Benjamin Moore 'Cotton Balls - OC122'; Or Approved Equal.

B. Epoxy Coating for Walls and Ceiling:
   1. Number of coats: Two.
   2. Product Characteristics:
      a. Dry film thickness, per coat, 6.0-8.0 mils., minimum Or Approved Equal.
   3. Top Coat(s): Polyamide Epoxy.
      a. Sheen: Gloss.
      b. Products:

4. Top Coat(s): High Performance Institutional, Two-Component, Water Based Coating.
   a. Sheen: Gloss.
   b. Products:

5. Filler and Primer: As specified under "PRIMERS" below.

2.4 PRIMERS

A. Primers: Provide the following unless another primer is required or recommended by coating manufacturer.
   1. Filler and Surfacer for Cementitious Substrate, Modified Polyamines Epoxy.
   2. Primer Sealer for Cementitious Substrates, Modified Polyamines Epoxy.

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 12 percent.
2. Plaster and Stucco: 12 percent.
3. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
4. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

A. Clean surfaces of loose foreign matter.

B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

C. Remove finish hardware, fixture covers, and accessories and store.

D. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches. Allow to dry.
   3. Prepare surface as recommended by coating manufacturer and according to SSPC-SP 13.

E. Masonry:
   1. Prepare surface as recommended by coating manufacturer.

F. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

G. Ferrous Metal:
   1. Solvent clean according to SSPC-SP1.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 “Commercial Blast Cleaning”, and protect from corrosion until coated.

H. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.3 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
B. Wood: Prior to priming patch with filler to produce smooth, even surface.

C. Concrete Masonry: Apply masonry filler to thickness required to fill holes and produce smooth surface; minimum thickness of 30 mils.

3.4 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.5 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.6 PROTECTION

A. Protect finished work from damage.

END OF SECTION 09 96 00
SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cash allowance for signs.
B. Room and door signs.

1.2 REFERENCE STANDARDS

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.

1.3 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
B. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
   2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   3. Submit for approval by Owner through Architect prior to fabrication.
C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Curved Sign Media Suction Cups: One for each 100 signs; for removing media.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.6 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flat Signs:
   2. Cosco Industries (ADA signs); ADA Series 1: www.coscoarchitecturalsigns.com.
   5. Or approved equal.

2.2 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as indicated on drawings.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: 1 inch.
   4. Sign Height: 6 inches, unless otherwise indicated.
   5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
   6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers indicated on the drawings, and braille.

C. Emergency Evacuation Maps:
   1. Map content to be provided by Owner.
   2. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.

D. Stenciling at rated construction required to have protected openings or penetrations.
   (IFC 703.7)
   1. Message Text: FIRE AND/OR SMOKE BARRIER—PROTECT ALL OPENINGS

2.3 SIGN TYPES

A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.

2.4 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
   1. Total Thickness: 1/16 inch.

2.5 NON-TACTILE SIGNAGE MEDIA

A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
   2. Total Thickness: 1/8 inch.

2.6 ACCESSORIES

A. Tape Adhesive: Double sided tape, permanent adhesive.
PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Install neatly, with horizontal edges level.
   C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
   D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION 10 14 00
SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Commercial toilet accessories.
B. Commercial shower and bath accessories.
C. Under-lavatory pipe supply covers.
D. Mirrors
E. Utility room accessories.

1.2  REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.3  ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and concealed ceiling supports to receive anchor attachments.

1.4  SUBMITTALS

A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.
PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   5. Or approved equal.

B. Provide products of each category type by single manufacturer.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.

B. Keys: Provide two set of keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.


F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.3 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Back paint components where contact is made with building finishes to prevent electrolysis.

2.4 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser: Double roll, surface mounted, for coreless type rolls.

B. Paper Towel Dispenser: Folded paper type, stainless steel, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock.

C. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator.
   1. Minimum Capacity: 40 fluid ounces.
   2. Refill Indicator: Window Type.

D. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
      a. Size: As indicated on drawings.
      b. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.

E. Grab Bars: Stainless steel, smooth surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings.

2.5 COMMERCIAL SHOWER AND BATH ACCESSORIES

A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.

B. Shower Curtain:
   1. Material: Nylon reinforced vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
   3. Size: 78 inches high, width to fit opening, hemmed edges.
   4. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
   5. Color: As selected from manufacturer's standard colors.
   6. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.

C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, left hand seat.
   1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected by Architect from manufacturers full range.
   2. Size: ADA Standards compliant.
D. Wall-Mounted Soap Dish: Normal duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate.

E. Towel Bar: Stainless steel, 3/4 inch square tubular bar; rectangular brackets, concealed attachment, satin finish.
   1. Length: 24 inches.

F. Shower Room Bench: Free standing type, laminated birch; satin stainless steel pedestals.
   1. Accessibility: Comply with ICC A117.1 and ADA Standards.
   2. Height: 18 inch.

2.6 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
   1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
   2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
   4. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.
   5. Allow service access without removing coverings.

2.7 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Hooks: Four, 0.06 inch stainless steel rag hooks at shelf front.
   2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
   3. Length: 34 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. Verify that field measurements are as indicated on drawings.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.
B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
   1. Grab Bars: As indicated on drawings.
   2. Mirrors: 40 inch, measured from floor to bottom of mirrored surface.
   3. Other Accessories: As indicated on drawings.

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 28 00
SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1  GENERAL

1.1 SECTION INCLUDES
   A. Fire extinguishers.
   B. Fire extinguisher cabinets.

1.2 REFERENCE STANDARDS
   A. NFPA 10 - Standard for Portable Fire Extinguishers.

1.3 SUBMITTALS
   A. Product Data: Provide extinguisher operational features.
   B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
   C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.4 FIELD CONDITIONS
   A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2  PRODUCTS

2.1 MANUFACTURERS
   A. Fire Extinguishers:
   B. Fire Extinguisher Cabinets and Accessories:

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   2. Size: 10 pound.

2.3 FIRE EXTINGUISHER CABINETS

A. Cabinet Configuration: Surface mounted type.
   1. Size to accommodate accessories.

B. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.

C. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level, 32 inches from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

END OF SECTION 10 44 00
SECTION 10 51 13 - METAL LOCKERS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Metal lockers.

1.2  REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.


1.3  SUBMITTALS

A. Product Data: Manufacturer's published data on locker construction, sizes and accessories.

B. Shop Drawings: Indicate locker plan layout, numbering plan.

C. Samples: Submit two samples 2 by 3 inches in size showing color and finish of metal locker material, of each color.

1.4  DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2  PRODUCTS

2.1  MANUFACTURERS

A. Metal Lockers:
   4. Or approved equal.

2.2  LOCKER APPLICATIONS

A. Staff Lockers: Metal lockers, wall mounted for base indicated on drawings.
Brandywine Zoo
QUARANTINE SUPPORT BUILDING
June 2, 2020
Project Manual
Division of Parks and Recreation Project No. WBZ-9

1. Width: 18 inches.
2. Depth: 18 inches.
3. Height: 72 inches.
5. Fittings: Size and configuration as indicated on drawings.
   a. Hat shelf.
   b. Single shoe shelf.
   c. Hooks: One double prong.
6. Ventilation: Louvers at top and bottom of door panel.
8. Provide sloped top.

2.3 METAL LOCKERS

A. Accessibility: Comply with ICC A117.1 and ADA Standards.

B. Lockers: Factory assembled, made of formed sheet steel, ASTM A653/A653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; metal edges finished smooth without burrs; baked enamel finished inside and out.
   1. Where ends or sides are exposed, provide flush panel closures.
   2. Provide filler strips where indicated, securely attached to lockers.
   3. Color: To be selected by Architect from manufacturer's full range.

C. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
   1. Body and Shelves: 24 gage, 0.0239 inch.
   2. Concrete Base Height: 4 inch.

D. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
   1. Door Frame: 16 gage, 0.0598 inch, minimum.

E. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
   1. Door Thickness: 16 gage, 0.0598 inch, minimum.
   2. Form recess for operating handle and locking device.

F. Hinges: Continuous piano hinge with powder coat finish to match locker color.

G. Sloped Top: 20 gage, 0.0359 inch, with closed ends.

H. Trim: 20 gage, 0.0359 inch.

I. Coat Hooks: Stainless steel or zinc-plated steel.

J. Number Plates: Provide rectangular shaped aluminum plates. Form numbers 1/2 inch high of block font style with ADA designation, in contrasting color.
PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify that prepared bases are in correct position and configuration.
   B. Verify bases and embedded anchors are properly sized.

3.2 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Place and secure on prepared base.
   C. Install lockers plumb and square.
   D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
   E. Bolt adjoining locker units together to provide rigid installation.
   F. Install end panels, filler panels, sloped tops, and miscellaneous panels.
   G. Install fittings if not factory installed.
   H. Replace components that do not operate smoothly.

3.3 CLEANING
   A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 51 13
SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Four post shelving.
B. Shelving accessories.

1.2 REFERENCE STANDARDS


1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Rated uniform shelf loads.
   2. Details of shelving assemblies, including reinforcement.
   3. Accessories.
B. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.
C. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.
D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.
E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspect for dents, scratches, or other damage. Replace damaged units.
B. Store in manufacturer's unopened packaging until ready for installation.
C. Store under cover and elevated above grade.
1.6 WARRANTY

A. Provide ten year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Four Post Shelving
   5. Or approved equal.

2.2 SHELVING - GENERAL

A. See drawings for layout and sizes.

B. Seismic Design: Design for Seismic Zone 1, in accordance with ASCE 7, Section 9.

2.3 FOUR POST SHELVING

A. Four Post Shelving (Keynotes:105613-A & 105613-B): Steel post-and-shelf type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
   1. Unit Width: 60 inches, center to center of posts.
   2. Shelf Capacity: 650 lbs. per shelving bay.
   3. Shelf Deflection: 1/4 inch in 36 inches, maximum, under specified uniform load.
   4. Adjustability of Shelving: Continuous along length of post.
   5. Shelf Depth: 24 inches, minimum.
   6. Unit Height: 72 inches, overall, maximum.
   7. Finish: Galvanized.
   8. Color: As selected by Architect from manufacturer’s standard range.
   9. Number of Units: As indicated on drawings.

B. Posts: Formed sheet members; perforations may be exposed on face of members.
   1. Metal Thickness: 16 gage, 0.0598 inch.
   2. Post Shape: Round intermediate posts, Round end posts forming corners.
   3. Post Diameter: 1 inches, maximum.
   5. Post Bases: Flat steel foot plate, with manufacturer’s recommended adjustable leveling device.
2.4 ACCESSORIES

   A. Kick Plates: Formed sheet metal; enclose open space between bottom shelf and floor on all front sides and open ends; finished to match.

PART 3 EXECUTION

3.1 EXAMINATION

   A. Verify that substrate is level and that clearances are as specified.
   B. Do not begin installation until substrates have been properly prepared.
   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. 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.
   B. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.
   C. Out-Of-Square Tolerance - Four Post Shelving: Maximum of 1/8 inch difference in distance between bottom shelf and canopy top, measured along any post in any direction.

3.4 CLEANING

   A. Clean shelving and surrounding area after installation.

3.5 PROTECTION

   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 10 56 13
SECTION 10 57 23 - CLOSET AND UTILITY SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall mounted wire closet shelving.
B. Accessories.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, with installation instructions.
B. Selection Samples: For each color selection required, submit color chips representing manufacturer's full range of available colors and finish.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.
C. Store flat to prevent warpage and bending.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wire Storage Shelving:
   4. Or approved equal.

2.2 SHELVING APPLICATIONS

A. Shelf Depth: 12 inches, unless otherwise indicated.
B. Storage Closets:
1. Wall-to-wall storage shelves, close-mesh cross wire spacing, stacked at 13 inch vertically, not less than 12 inch deep.

2.3 MATERIALS

A. Wire Shelving: Factory-assembled coated wire mesh shelf assemblies for wall-mounting, with all components and connections required to produce a rigid structure that is free of buckling and warping.
   1. Construction: Cold-drawn steel wire with average tensile strength of 100,000 psi resistance welded into uniform mesh units, square, rigid, flat, and free of dents or other distortions, with wires trimmed smooth.
   2. Coating: PVC or epoxy, applied after fabrication, covering all surfaces.
   3. PVC Coating: 9 to 11 mils thick.
   4. Epoxy Coating: Non-toxic epoxy-polyester powder coating baked-on finish, 3 to 5 mils thick.
   5. Standard Mesh Shelves: Cross deck wires spaced at 1 inch.
   6. Shelf and Rod Units: Integral hanging rod at front edge of shelf.

B. Hanging Rod: Tubular steel, 1 inch diameter, with end caps on open ends.
   1. Finish: Epoxy powder coat.
   2. Wall Thickness: 20 gage, 0.035 inch.
   3. Provide corner hanging rods and hanging rod connectors where required.

C. Mounting Hardware: Provide manufacturer's standard mounting hardware; include support braces, wall brackets, back clips, end clips, poles, and other accessories as required for complete and secure installation; factory finished to match shelving.

D. Fasteners: As recommended by manufacturer for mounting substrates.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect areas to receive shelving, to verify that spaces are properly prepared to receive shelf units, and are of dimensions indicated on shop drawings.

B. Verify appropriate fastening hardware.

C. Do not begin installation until substrates have been properly prepared.

D. 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. 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, with shelf surfaces level.

B. Cap exposed ends of cut wires.

C. Install back clips, end clips at side walls, and support braces at open ends. Install intermediate support braces as recommended by manufacturer.

D. Mounting Heights:
   1. Single Hanging Rod Units: Install shelf at 68 inches above floor.
   2. Other Shelves: See drawings.

3.4 CLEANING

A. Clean soiled surfaces after installation.

3.5 PROTECTION

A. Protect installed work from damage.

B. Touch-up, repair, or replace damaged products before Substantial Completion in a manner that eliminates evidence of replacement.

END OF SECTION 10 57 23
SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS

PART 1   GENERAL

1.1   SECTION INCLUDES

   A. Horizontal slat louver blinds.
   B. Operating hardware.

1.2   REFERENCE STANDARDS

   A. WCMA A100.1 - Safety of Window Covering Products.

1.3   SUBMITTALS

   A. Product Data: Provide data indicating physical and dimensional characteristics.
   B. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
   C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. Extra Blind Assemblies: One of each size.
      2. Extra Lift Cords, Control Cords, and Wands: One of each type.

PART 2   PRODUCTS

2.1   MANUFACTURERS

   A. Horizontal Louver Blinds:
      2. Levolor; Metal Blinds: www.levolor.com/commercial/#sle.
      3. Or approved equal.

2.2   BLINDS

   A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
   B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.
C. Blinds: Horizontal slat louvers hung from full-width headrail with full-width bottom rail; manual control of raising and lowering by cord with full range locking; blade angle adjustable by control wand; complying with WCMA A100.1.

D. Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
   1. Width: 2 inch.
   2. Color: As selected by Architect.

E. Slat Support: Woven polypropylene cord, ladder configuration.

F. Head Rail: Pre-finished, formed aluminum box, with end caps, internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.

G. Control Wand: Extruded hollow plastic; hexagonal shape.

H. Headrail Attachment: Wall brackets.

2.3 FABRICATION
A. Determine sizes by field measurement.
B. Fabricate blinds to cover window frames completely.

PART 3 EXECUTION
3.1 INSTALLATION
A. Install blinds in accordance with manufacturer's instructions.
B. Secure in place with flush countersunk fasteners.

3.2 TOLERANCES
A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.
B. Maximum Offset From Level: 1/8 inch.

3.3 CLEANING
A. Clean blind surfaces just prior to occupancy.

3.4 SCHEDULE
A. See drawings.

END OF SECTION 12 21 13
SECTION 12 31 00 - MANUFACTURED METAL CASEWORK

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Manufactured standard casework, with cabinet hardware.

B. Countertops.

1.2  REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.


C. BHMA A156.9 - American National Standard for Cabinet Hardware.

1.3  ADMINISTRATIVE REQUIREMENTS

A. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.

1.4  SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Component dimensions, configurations, construction details, joint details, and attachments; manufacturer's catalog literature on hardware, accessories, and service fittings, if any.

C. Shop Drawings: Indicate casework types, sizes, locations, using large scale plans, elevations, cross sections. Include rough-in and anchors, placement dimensions and tolerances, clearances required, and keying information.

D. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

G. Maintenance Data: Manufacturer's recommendations for care and cleaning.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section during handling and installation, including finished surfaces and hardware items. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

B. Accept casework on site. Inspect on arrival for damage.

C. Coordinate size of access and route to place of installation.

1.7 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
   1. Ruptured, cracked, or stained finish coating.
   2. Discoloration or lack of finish integrity.
   3. Cracking or peeling of finish.
   4. Failure of hardware.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Casework:
   3. ICIscientific; CornerStone Series: www.iciscientific.com/#sle.
   4. Or Approved Equal.
2.2 FABRICATION (KEYNOTE: 123100-A)

A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.

B. Casework: Die-formed metal sheet; each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
   1. Style: Flush overlay - square edge.
   2. Primary Cabinet Material: Cold-rolled steel.
   3. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with the following front-to-back dimensions:
      a. Base Cabinets: 24 inches.
      b. Wall Cabinets: 14 inches.
   4. Steel Sheet Metal:
      a. Gables, Front and Back Panels, Gusset Plates, Aprons, and Rails: 18 gage, 0.0478 inch minimum thickness.
      b. Drawers, Cabinet Floors, Shelves, Filler Panels and Drawer Dividers: 20 gage, 0.0359 inch minimum thickness.
      c. Backing Sheet to Door and Door Fronts: 18 gage, 0.0478 inch minimum thickness.
   5. Structural Performance: Provide components that safely support the following minimum loads, without deformation or damage:
      a. Base Units: 500 pounds per linear foot across the cabinet ends.
      b. Suspended Units: 300 pounds, minimum, static load.
      c. Hanging Upper Cases: 300 pounds.
      d. Shelves: 200 pounds.
   6. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
   7. Edges and Seams: Smooth. Form facing, shelves, and drain boards from continuous sheets.
   8. Shelf Edges: Turned down 3/4 inch on each side and returned 3/4 inch front and back.
   10. Welding: Electric spot welded; joints ground smooth and flush.
   11. Doors: Fabricate door fronts of sandwiched sheets of sheet steel welded together and reinforced for hardware.
      a. Fill with sound-deadening core.
   12. Fittings and Fixture Locations: Cut and drill countertops, backs, and other casework components for service outlets and fixtures.
   13. Removable back panels on all base cabinets.
   14. Fixed panels at backs of open spaces between base cabinets and at ends of utility spaces not otherwise enclosed.
15. Filler Panels (Keynote: 123100-B): Flanged on both sides, of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.

16. Separation: Use bituminous paint or non-conductive tape to coat metal surfaces in contact with cementitious materials, and to separate dissimilar metals.

2.3 CABINET HARDWARE

A. Manufacturer's standard types, styles and finishes.

B. Conform to BHMA A156.9 requirements.
   1. Acceptable base materials for plated finishes include steel.

C. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.
   1. Hinged Doors: Cam type lock, satin chromium plated over nickel on base material.
   2. Keying: Key locks alike within a space, key each room separately.
   3. Master Key System: All locks operable by master key.

D. Shelves in Cabinets:
   1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.

E. Swinging Doors: Hinges, pulls, and catches.
   1. Hinges: Semi-concealed, number as required by referenced standards for width, height, and weight of door.
      a. Semi-Concealed Hinges: Installed as required by hinge design, satin chromium plated over nickel on base material.
         1) Butt hinges installed on cabinet face, and on door face for overlay doors; five-knuckle, projecting barrel, minimum 2-1/2 inches long.
         2) Pivot hinges installed on cabinet face, and on door back, top and bottom door mount.
   2. Pulls: Chrome decorative design, 4 inches wide.
   3. Catches: Magnetic.

F. Fixed Americans with Disabilities Act (ADA)-Compliant Vanity and Countertop Brackets (Keynote: 123100-D):
   1. Material: Steel.
   2. Finish: Manufacturer's standard, factory-applied, textured powder coat.
   3. Finish: Brushed; with clear, factory-applied coating.
   5. Products:
      a. A&M Hardware, Inc.; ADA Vanity Brackets:
2.4 COUNTERTOPS

A. Solid Surface Countertops (Keynote: 123100-C) : Homogeneous solid sheets of filled plastic resin complying with ISSFA-2
   1. Manufacturer: Corian Solid Surface Or Approved Equal.
      a. Color to be selected by Architect from Manufacturer's full range of colors.

2.5 MATERIALS

A. Sheet Steel: High-strength low-alloy, cold rolled and leveled unfinished steel sheet, ASTM A1008/A1008M, Class 1 (matte) finish.

B. Sound Deadening Material: Inorganic, for sandwich panel fabrication.

2.6 FINISHES

A. Metal (Except Stainless Steel): Degrease and phosphate etch followed by primer; minimum two coats electrostatic enamel; ________ color to selected from manufacturer's selection.

B. Shop finish all components.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of support framing and anchors.

B. Verify that service connections are correctly located and of proper characteristics.

3.2 INSTALLATION

A. Install casework, components and accessories in accordance with manufacturer's instructions.

B. Large Components: Ensure that large components can be moved into final position without damage to other construction.

C. Use anchoring devices to suit conditions and substrate materials encountered.

D. Set casework items plumb and square, securely anchored to building structure, with no distortion.
1. **Base Cabinets:** Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.

2. **Wall Cabinets:** Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
   a. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 feet and 1/2 inch in 20 feet or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
   b. Maximum variation of finished gypsum board surface from true flatness exceeds 1/8 inch in 10 feet in any direction.

   E. Align cabinets to adjoining components.

   F. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
      1. Variation of tops of Base Cabinets from Level: 1/16 inch in 10 feet.
      2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
      3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
      5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

3.3 **ADJUSTING**

   A. Adjust operating parts, including doors, drawers, hardware, fixtures to function smoothly.

3.4 **CLEANING**

   A. Clean casework, counters, shelves, legs, hardware, fittings and fixtures.

3.5 **PROTECTION**

   A. Do not permit finished casework to be exposed to continued construction activity.

   B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.

   C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

**END OF SECTION 12 31 00**
SECTION 22 01 01 - PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for all plumbing work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Commissioning requirements: Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers


1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 22.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, including all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Plumbing work of this project includes, as a brief general description, the following:

1. New building water service with liquified petroleum-fired (LP gas) water heater.
2. Plumbing fixtures as indicated on the floor plans.
3. Sanitary, vent and storm water systems.
F. See Division 01 for requirements related to limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 22 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in the article "Substitutions," below, for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.

2. Where specification permits "equal" products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 22 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.

2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction, and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

   1. Furnish: Supply item
   2. Install: Mount and connect item
   3. Provide: Furnish and install.

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.
G. General Conditions describe the correlation and intent of the Contract Documents. In
case of discrepancies between the specifications and drawings, the specifications should
be followed as to the general methods and principles and the drawings followed as to
sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect
will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications
or drawings, it is the responsibility of the Contractor to notify the Architect of said
uncertainty, doubt, or conflict and obtain a decision as to the intent before starting any
work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any
equipment or item where shown on the drawings, call the situation to the attention of the
Architect and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without
undue delay, and in conformance with project schedule. Submit samples, shop drawings,
schedules, insurance policies and certificates, and the like in time to avoid delays in
actual construction. Coordinate plumbing work so that work of each trade is completed
before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades
allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all piping, ductwork, light fixtures, equipment, and
appurtenances in such a manner that the finished installation is as indicated on drawings.
In the event difficulties are encountered which prevent this, it is the Contractor’s
responsibility to bring this to the attention of the Architect prior to initiation of work.
Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent foreman, who shall be on the
premises at all times to check, layout, coordinate and superintend the installation of work.
The foreman shall establish all grades and lines relative to the work before starting, and
be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers’ and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all
equipment, materials and subcontractors used for the work of this division. Lists shall
follow the sequence of the specifications. No considerations will be given for partial
or incomplete lists. After review of lists, submit shop drawings and product data.
B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of shop drawings and product data for every item of equipment. Shop drawings or product data will not be considered until manufacturers' lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor’s name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. All exclusively electrical items furnished as items associated with plumbing items but not specifically described in the plumbing item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the plumbing item by identification specification paragraph.
5. Product data sheets shall be 8.5-inch by 11-inch cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.
1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer’s direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:
   
   b. Specifications
   c. Addenda
   d. Change orders and other modifications to the Contract
   e. Reviewed shop drawings, product data, and samples

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:
   
   a. Manufacturer's name and product model and number
   b. Product options, substitutions, or alternates utilized
   c. Changes made by addenda and modifications

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:
   
   a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
   c. Field changes of dimension and detail.
   d. Details not on original Contract Drawings.
6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.

2. Lubrication charts: Prepare lubrication charts for each piece of mechanical equipment that requires grease or oil.
   a. Include the following:
      (1) Types of lubricants required
      (2) Locations of lubrication points
      (3) Frequency of lubrication.
   b. Provide one extra set of lubrication charts mounted in plastic covers, besides those required in Operating and Maintenance Manuals.

3. Binders: Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.

4. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project. Print on spine of binder "O & M INSTRUCTIONS." If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.

5. Internally subordinate the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

6. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.

7. Part 1: Directory, listing names, addresses, and telephone numbers of mechanical engineers; Contractor; mechanical subcontractors; and major mechanical equipment suppliers.

8. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
   a. Significant design criteria, including pump curves and similar performance charts.
   b. List of plumbing equipment, including operating weight of each.
   c. Parts list for each plumbing fixture, faucet, and pump, including recommended spare parts list.
   d. Operating instructions.
   e. Maintenance instructions for plumbing equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
g. Valve charts, including locations of flow fittings.
h. New burner installations: Include firing rate, nozzle size, and fuel pressure.

9. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data for plumbing systems.
b. Water balance reports.
c. Photocopies of certificates.
d. Photocopies of warranties and guarantees.
e. Test reports: Copies of the results of all tests required under all sections of specifications.

10. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.

11. Submit final volumes revised, within ten days after final inspection.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The plumbing, mechanical, electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply. Products shall be certified by manufacturers to meet the requirements of referenced standards.

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Movement and Control Association (AMCA)
3. Associated Air Balance Council (AABC)
4. American Association State Highway and Transportation Officials (AASHTO)
5. American National Standards Institute (ANSI)
6. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
7. ASME International (ASME)
9. American Society of Sanitary Engineering (ASSE)
10. American Water Works Association (AWWA)
11. International Code Council (ICC)
12. Manufacturer's Standardization Society of the Valve and Fittings Industry Inc. (MSS)
13. National Electrical Code, NFPA 70 (NEC)
14. National Electrical Manufacturer's Association (NEMA)
15. National Fire Protection Association (NFPA)
17. National Sanitary Foundation (NSF)
19. The Occupational Safety and Health Act (OSHA)
20. Piping and Drainage Institute (PDI)
21. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
22. Underwriters Laboratory Inc. (UL)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.
1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Seal off all return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract Sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer’s recommended temperatures.

E. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:
   1. Promptly notify the Owner and Architect in writing.
   2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

   1. Service reports for warranty work shall be provided to the Owner.

C. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers’ standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.
F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.19 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor’s and subcontractors’ responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of pipes, ducts and appurtenances. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS
A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION
SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic material and equipment required for the plumbing equipment and piping work as indicated on the drawings and specified in Division 22.

B. Other requirements applicable to more than one section of Division 22.

C. Identification of plumbing systems and equipment.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 22 01 01.

B. Operation and Maintenance Manuals: Division 01 and Section 22 01 01.

C. Painting: Division 09.

D. Commissioning requirements: Division 01.

1.3 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.

2. NVLAP: A testing agency accredited according to NIST’s National Voluntary Laboratory Accreditation Program.

C. DN: Dimension Nominal, nominal pipe size in millimeters, in accordance with the metric system for construction, System International (SI).
D. NPS: Nominal pipe size in inches, in accordance with standard U.S. designations for manufactured pipe. Pipe sizes do not change when projects are designed and built in metric units; each size has a consistent name (nominal dimension) in each system.

1.4 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed based on using the particular manufacturer’s products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article “Acceptable Manufacturers,” or permitted as “equal,” are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that render their use impractical, or cause functional fit, access, or connection problems.

D. The contract drawings are generally diagrammatic and do not indicate all fittings or offsets in pipe, all access panels, or other specialities required.

1. Install pipe exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining proper clearances for access at all parts requiring servicing.
2. Install pipe a sufficient distance from other work to permit a clearance of not less than 0.5 inch (15 mm) between its finished covering and adjacent work.
3. No pipe shall be run below the head of a window or door.

E. Equipment and pipes installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6’-8”, unless otherwise noted.

1. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.

1.5 SUBMITTALS

A. Shop drawings:

1. Showing proposed expansion design.
2. Schedule of welding and brazing procedures proposed for each piping system included in the project.
B. Certifications: Proof of operator and testing agency personnel qualifications as required for welding and brazing in the article “Quality Assurance” below.

C. Test reports: Field test results for each piping system as specified in Part 3 below.

1.6 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the plumbing, mechanical, electrical, building, fire, health and safety, and other applicable codes and regulations of the state, county or city in which the work is performed.

   1. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

B. Welding procedures and operator qualifications for structural welding: AWS D1.1, Structural Welding Code Steel, electric arc process.

C. Welding, brazing, and soldering procedures and operator qualifications for building systems piping:

   1. AWS D10.9, Qualification of Welding Procedures and Welders for Piping and Tubing.
   2. ASME B31.9, Building Services Piping.
   3. Copper Development Association “Copper Tube Handbook.”

D. Qualifications of independent testing laboratory personnel:

   1. Welding inspectors: AWS QC1, Certification of Welding Inspectors.

E. Electrical control panels, equipment, materials and devices provided or installed as work of Division 22 shall bear UL label or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70 (NEC). Provide testing, if required, without addition to the contract sum.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors’ and subcontractors’ responsibilities are described in Division 01.

PART 2 - PRODUCTS
2.1 MATERIALS

A. General piping techniques, testing, identification, painting, and operating instructions specified in this section apply to products specified in other sections of Division 22.

B. Weldolets and thredolets: Fittings designed for installing branches on piping, with either welded or threaded connection to branch; conforming to ASTM A 234.

C. Solder: Free of lead, antimony, and zinc and meeting the requirements of ASTM B 32. No solder containing lead is permitted.
   1. Tin 95.5 percent, copper 4 percent, and silver 0.5 percent; equal to “Silvabrite 100” manufactured by Engelhard Corporation.
   2. Tin, copper, bismuth, and silver; equal to “Oatey Silver” manufactured by Oatey.

D. Flux: Meeting the requirements of ASTM B 813 and NSF 61 certified, equal to Oatey H-2095.

E. Pipe jointing compound:
   1. Polytetrafluoroethylene (PTFE) pipe thread tape, “Teflon.”
   2. Pipe cement and oil.

F. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by ALSC Board of Review.
   1. Application: Treat items indicated on the drawings, and the following:
      a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
      b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
      c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
      d. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
      e. Wood floor plates that are installed over concrete slabs-on-grade.

2.2 MATERIALS FOR UNDERFLOOR INSTALLATION

A. Pipe: Copper tubing, ASTM B 88, Type L soft drawn, no joints under floor.
B. Conduit: Schedule 40 PVC pipe, size to accommodate copper tubing and insulation.

C. Insulation: Flexible elastomeric, as specified in Section 22 07 19, Plumbing Piping Insulation.

D. Firestopping caulk: Equal to Three M CP 25 WB, intumescent caulk, which, under heat, expands to five times its original volume, creating a char which can withstand flames and smoke for at least three hours.

2.3 MATERIALS FOR BACKBOARDS FOR PIPING SPECIALTIES

A. Provide wall-mounted backboards for mounting piping specialties consisting of plywood board, supports, and fasteners.

1. Backboard: Moisture-resistant marine plywood, locations and sizes as indicated on the drawings.
2. Supports: Vertical backing rails, corrosion resistant, consisting of FRP composite structural shapes as indicated on the drawings.
3. Fasteners: Corrosion-resistant fasteners suitable for secure anchorage into wall construction behind backboards.

B. Marine plywood: BS-1080, Veneer Grade A/B, moisture-resistant marine plywood, spruce-pine-fir multiple ply, 5-ply minimum, pressure-treated construction, 0.563-inch (14-mm) thick minimum

C. Fiber reinforced plastic (FRP) composite structural shapes: ASTM D 635 and E 84, Pultruded FRP structural shapes, non-corrosive, flame retardant, thermosetting polyester resin, composite factory-fabricated shapes for assorted assemblies and field erection.

1. Ultimate tensile strength: 30,000 psi (207 MPa).
2. Modulus of elasticity: 2.8 x 106 psi (19,300 MPa).
3. Specific gravity: 1.6 to 1.75.
4. Density: 0.062 to 0.070 pounds/cubic inch (1.72 to 1.94 grams/cubic centimeter).
7. Shapes and sizes as indicated on the drawings
8. Submit shop drawings of assemblies.
9. Acceptable manufacturers:
   a. Bedford Reinforce Plastics Company
   b. Composites USA, Inc.
   c. Liberty Pultrusions, Inc.
   d. Strongwell Corporation
   e. Structural Fiberglass, Inc.
   f. Or approved equal.
2.4 IDENTIFICATION DEVICES AND MATERIALS

A. Stenciling materials:

1. Stencils: Manufactured standard stencils prepared for required applications, conforming to ANSI A13.1 for color and size of legend letters, including arrows showing direction of flow.
2. Paint: Exterior type enamel, colors conforming to ANSI A13.1, or black.

B. Equipment identification tags:

1. Laminated plastic with adhesive back, white core and black outer layers, which, when engraved, will produce white letters and numerals on a black background.
2. Tags installed on curved surfaces shall be aluminum or brass.

C. Valve tags: Brass, 1.5 inch (40 mm) in diameter with black-filled numbers not less than 0.25 inch (6 mm) high, complete with brass attachment chains.

D. Ceiling identification tags: Laminated plastic with adhesive back, engraved black letters on white background, minimum 0.5 inch (15 mm) wide and length as required for 0.375 inch (10 mm) high letters for name of concealed device and number.

2.5 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers’ instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers’ instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers’ instructions and the drawings or specifications.

3.2 INSTALLING PIPING UNDER FLOOR SLAB
A. Install conduit.

B. Insulate copper tubing and insert in conduit.

C. Where piping rises through floor, cut conduit and insulation flush with floor.

D. Fill annular spaces with firestopping caulk. Use fiberglass insulation as backing.

3.3 PIPE INSTALLATION

A. Remove burrs resulting from cutting pipe or from any other operation.

B. Threaded connections:
   1. Cut threads full and clean.
   2. Apply specified pipe jointing compound or tape on male threads only.
   3. Where piping is installed in crawl spaces and tunnels, cover exposed threads with either bituminous protective coating or rust-inhibitive paint. Apply after joints have been assembled and tested.

C. Thoroughly clean pipe and fittings before they are installed, and keep them clean until the acceptance of the completed work. Cap or plug the ends of the lines so as to prevent earth and other debris from entering during construction.

D. Provide for expansion and contraction of piping and connections so that no strain or breakage will occur.

E. Provide for draining all parts of water piping systems and apparatus by installing a valved hose connection at every low point.

F. Black steel piping NPS 2.5 (DN 65) and larger shall be welded; NPS 2 (DN 50) and smaller shall be threaded, except as required otherwise in a particular section.

G. Use welding fittings, tees, wyes, reducers, eccentric reducers, and caps as required. Branches at least two nominal pipe sizes less than the main may be made with “Weldolets” or “Thredolets” installed with full size opening in larger pipe and in accordance with manufacturer’s printed instructions. Flanges shall be welded neck or slip-on pattern of class to suit the valves or equipment connections. Flanges shall have machine bolts with hex nuts and washers.

H. Each connection from risers to equipment shall contain at least three elbows or expansion joints. Connections shall be so arranged that movement in piping due to expansion and contraction will not be transmitted to the equipment.
I. Install unions and flanges in the piping at each item of equipment, control valve, and appliance, so as to provide easy removal of the equipment, valve, or appliance.

J. Pitch water piping so that air in the system can be properly vented. Provide stop valves where necessary to isolate parts of system for repairs without draining the entire system.

K. Special techniques: Follow the techniques for soldering and brazing pipe, fittings, and valves as recommended by the manufacturer.

3.4 COPPER TUBING FOR WATER INSTALLATION

A. Solder joints for copper tubing: Clean ends of tubing and inside of fitting ends thoroughly with emery cloth before applying flux.

B. Make flare joints in copper tubing with proper size flaring tool and in accordance with manufacturer’s recommendations.

C. Provide isolation fittings between copper and steel piping to prevent electrolysis.

D. Cut pipe with a tubing cutter or fine-tooth saw. Cuts made with a saw shall be true and square, and the end shall be filed smooth with a fine-tooth file. Remove all marks and burrs with sandpaper.

3.5 PLASTIC PIPING INSTALLATIONS

A. Cut pipe true and square with a fine-tooth saw and file the end smooth with a fine-tooth file. Remove all saw marks and burrs with sandpaper.

B. Clean connecting surfaces of both pipe and fitting with methyl ethyl ketone or acetone.

C. Apply solvent cement liberally with clean brush, first to fitting and then to pipe (outer surface and end). Lap cement a minimum of 0.25 inch (6 mm) over depth of fitting.

D. Join pipe and fitting to full depth of fitting, giving fitting at least one-quarter turn on pipe to distribute cement.

E. Pipe and fitting shall show a small fillet or bead completely around pipe without any voids, or fitting shall be cut out and new fitting made up and installed. Allow a minimum of 48 hours drying time for each joint.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Where it is necessary to run pipes through walls, provide finished, permanent, waterproof installation complete with inserts, sleeves, supports or hangers, seals, and other
appurtenances as required. Do not pierce, cut, or notch any footing or other structural member.

B. Waterproofing and damp proofing of the building shall be unharmed by the installation of the work. Where pipe has to pierce waterproofing or damp proofing, including outside walls, the penetration shall be made watertight. Waterproofing damaged or destroyed shall be repaired or replaced with new waterproofing.

3.7 IDENTIFICATION

A. General: Do not apply identification until insulation and finish painting work is complete.

B. Equipment:

1. Stencil equipment with minimum two-inch (50-mm) -high letters or provide identification tags. Clearly identify function, equipment served, and area served.
2. Firmly fasten each identification tag to its appropriate piece of equipment with drive screws, sheet metal screws, or rivets. Do not interfere with operation of, or damage the item being marked.

C. Piping:

1. Mark by stenciling.
2. Mark to identify service with arrows showing direction of flow. Apply markings near building walls where pipes enter or leave an accessible space and in intermediate locations so that markings are no more than 30 feet (9 m) apart. They shall be readily visible to a person standing on the floor.
3. Fully identify all piping installed as work of the project.
4. Mark pipe with letters of height and with colors as required by OSHA and conforming to ANSI A13.1.
5. Identify every thermometer, gauge, and control device.
6. Provide valve tags for all valves except stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.

D. Ceiling identification tags: Provide on the access door or, in suspended ceilings, on the ceiling support adjacent to the unit.

1. Valves: Identify with the same number shown on the valve tag.

3.8 PIPING TESTS

A. Notify Owner at least 24 hours prior to the actual test in writing.
B. Test before pipes are concealed or insulated. Test the piping in sections as the work progresses, so as not to delay progress of the building construction. Furnish pumps and gauges required for testing.

C. Conduct piping tests before connecting equipment that would be subject to damage from the test pressure. Replace piping or fittings found defective with new material.

D. Bracing and supporting: Adequately brace and support piping during the test, so that no movement, displacement, or damage results from the application of the test pressure.

E. Interior sanitary and storm drainage piping:

   1. Before connection of the plumbing fixtures and before connection to the sewer, cap or plug the entire sanitary, condensate, and storm drainage piping systems of the building.
   2. Test following the methods of testing required by the plumbing code, and no less than the duration and pressures required in the Schedule of Piping Systems Tests.
   3. Where pipes are in trenches, leave the trenches open until the completion of the test.

F. Test exterior gravity sanitary and storm sewer piping by the exfiltration method. Backfill over sewers to a minimum depth of two feet of cover prior to tests. Plug the lower manhole, filling the section between manholes with water and measuring the drop in water level in the upper manhole. Furnish water for testing, and maintain it at levels directed by the Architect, for a period of at least 24 hours. Repair or replace all visible leaks and all defects to meet the maximum allowable leakage shown in the Sewer Piping Test Schedule at the end of this section.

G. Test the piping systems for not less than four hours to fulfill the conditions in the Piping Systems Test Schedule at the end of this section.

H. Documentation of tests: Prepare a test report for each portion of piping tested, identified by service, material, location, and pipe size. Include these items:

   1. Date of test.
   2. Starting and completion times.
   3. Initial test pressure.
   4. Final test pressure.
   5. Problems or leaks detected.
   6. Corrective actions taken.
   7. Record of successful completion of testing.
   8. Name, title, and signature of person conducting test.

3.9 CLEANING AND PAINTING
A. Cleaning: Clean all piping and equipment. Where items are to be painted, clean ready for painting.

B. Painting: Coordinate painting with requirements of Division 09. Paint the items identified below to be painted. Use paint materials and systems specified in Division 09.

C. Items to be painted:

1. Items identified below to have protective coating.
2. Items furnished with manufacturer’s prime coat.
3. Mechanical rooms:
   a. Insulation and uninsulated steel: Piping, pumps, tanks, and vessels.
   b. Hangers and supports.

4. Piping exposed in finished spaces, insulated and uninsulated.

D. Items not to be painted: Copper, stainless steel, and equipment furnished with manufacturer’s finish.

E. Paint systems in mechanical rooms: Paint piping using colors in accordance with ANSI A13.1.

   1. Galvanized steel: One coat of primer recommended for galvanized surfaces and one coat of glossy alkyd enamel.
   2. Ferrous metal: One coat of primer recommended for ferrous metal and one coat of glossy alkyd enamel.
   3. Items protected with bituminous coating or rust-inhibitive primer: Finish coat of compatible glossy enamel.

F. Paint systems for exposed piping: Primer compatible with the substrate, whether steel, galvanized steel, insulation jacket, or other material; one coat or two, if required to cover, to match adjacent surfaces in color and texture.

3.10 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate all the plumbing systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of all systems and equipment.
1. Instructions by manufacturer’s technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Architect.

3.11 SCHEDULES

A. Sewer Piping Test Schedule:

<table>
<thead>
<tr>
<th>Dia. of Sewer in (mm)</th>
<th>Leakage Gal/100 ft./24 hrs (L/M/24 hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 (150)</td>
<td>76 (9.4)</td>
</tr>
<tr>
<td>8 (200)</td>
<td>95 (11.8)</td>
</tr>
<tr>
<td>10 (250)</td>
<td>114 (14.1)</td>
</tr>
<tr>
<td>12 (300)</td>
<td>133 (16.5)</td>
</tr>
<tr>
<td>15 (380)</td>
<td>170 (21.1)</td>
</tr>
<tr>
<td>18 (460)</td>
<td>190 (23.6)</td>
</tr>
<tr>
<td>21 (535)</td>
<td>208 (25.8)</td>
</tr>
<tr>
<td>24 (610)</td>
<td>227 (28.2)</td>
</tr>
</tbody>
</table>

B. Piping Systems Test Schedule:

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEST PRESSURE PSIG (kPa)</th>
<th>ALLOWABLE DROP</th>
<th>MEDIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic water service and exterior water piping</td>
<td>150 (1030)</td>
<td>None</td>
<td>Water</td>
</tr>
<tr>
<td>Domestic water, cold &amp; hot, and recirculated</td>
<td>125 (860)</td>
<td>None</td>
<td>Water</td>
</tr>
<tr>
<td>Air conditioning condensate drain</td>
<td>4.3 (30)**</td>
<td>None</td>
<td>Water</td>
</tr>
<tr>
<td>Sanitary waste</td>
<td>4.3 (30)**</td>
<td>None</td>
<td>Water</td>
</tr>
<tr>
<td>Storm</td>
<td>4.3 (30)**</td>
<td>None</td>
<td>Water</td>
</tr>
</tbody>
</table>

** Where piping is above food service area, test pressure shall be 11 psig (76 kPa).

END OF SECTION
SECTION 22 05 01 - EXCAVATION AND FILL FOR PLUMBING WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for plumbing work underground inside the building and extending five feet beyond exterior building walls, and outside the building as shown on drawings.

B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 22 01 01.


1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft, 2500 kN-m/cu m).

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities and proposed detailed trenching plan.

B. Product data:

1. Warning tape
2. Seed and mulch

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.
B. Underground warning tape: Polyethylene 0.004 inch (0.102 mm) thick for metallic lines, and for non-metallic lines polyethylene both sides with metallic lining, six inches (152 mm) wide.

1. Colors: In accordance with APWA and AASHTO standards.
2. Markings: Repeated continuously along the entire length, legend appropriate for line being identified.

C. Grass seed: Fresh new-crop seed, 90 percent pure and 85 percent germination. Mix: 70 percent Kentucky Bluegrass, 25 percent Red Fescue and 5 percent Red Top. Only strains of Kentucky Bluegrass found adaptable to Maryland shall be acceptable.

D. Mulch: Free of sticks, weeds, or other foreign matter; either licorice root, tan root, or tan bark; fibrous by-product of extraction. Use only one type throughout the project.

2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local utility company underground information service (BGE Miss Utility) before beginning excavation outside buildings.

B. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.
D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the Architect.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where piping is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:

1. Water piping: 42 inches (1067 mm).
2. Sewer lines: Elevations shown on drawings.

C. Trenches shall be of necessary depth and width for the proper laying of pipe with a minimum of 8 inches (205 mm) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulations are more strict, trenches 4 ft. (1220 mm) and deeper shall have shored sides as required by OSHA trenching regulations.
2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except for bell holes and for the proper sealing of the pipe joints.
3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day's operation.
4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.

5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the Architect and do not place any portion of the work on such surfaces until instructions are received.

E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

F. Excavation for manholes and similar structures shall be sufficient to leave a minimum of 12 inches (305 mm) and a maximum of 24 inches (610 mm) clearance on all sides. Fill over-depth excavation with concrete.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.

C. Plumbing systems backfill:

1. Backfill and compact in six-inch (150-mm) layers up to spring line of the pipe. The installations shall then be inspected and tested.

2. Following inspection, backfill in six-inch (150-mm) layers, each compacted, until the pipe has a cover of not less than one foot (305 mm). Place the remainder of the backfill material in the trench in eight-inch (200-mm) compacted layers.

3. Excavations improperly backfilled shall be reopened, then refilled and compacted to the required grade and compaction, and smoothed off.

4. Open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that the entire depth of trench shall be backfilled in six-inch (150-mm) layers, and each layer shall be mechanically compacted.

5. Completed work shall have uniform graded surface, in accordance with the surface and grade indicated on the drawings.
D. Structure backfill:

   1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.

3.6 COMPACtion

   A. Test in accordance with the requirements of ASTM D 1557.

   B. Compact under slabs, roads, and sidewalks to a 95 percent density.

   C. Compact unpaved areas to a 90 percent density.

   D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

   E. Take particular care in compaction of earth under joints of plumbing piping.

3.7 SEEDING

   A. Seed disturbed grass areas at the rate of 5 pounds (2.27 kg) per 1000 sq. ft. (92.9 sq. m), with the seed mix specified.

   B. Uniformly distribute seed with an approved machine to ensure a covering of plus or minus 0.25 inch (6 mm). Sow half of the seed in one direction and the rest at right angles.

   C. Do not seed during windy weather or when ground is wet or otherwise untillable. Seed between the dates of March 1st to May 1st or August 15 to October 15 unless otherwise approved in writing.

3.8 MULCHING

   A. Mulch seeded areas immediately following seeding with fibrous mulch evenly applied at an average rate of 2 tons per acre (4483 kg per hectare) so as to provide a loose depth of not less than 2 inches (50 mm).

   B. Wet down mulch, unless a heavy rain wets it, to the Architect's satisfaction, immediately after application.

END OF SECTION
SECTION 22 05 02 - SLEEVES AND PLATES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sleeves and escutcheon plates for piping systems.

B. Mechanical seals for piping penetrations.

1.2 SUBMITTALS

A. Product data: Sleeves, plates, sealants, and mechanical penetration seals.

PART 2 - PRODUCTS

2.1 SLEEVES, PLATES, AND ACCESSORIES

A. Steel sleeves: Schedule 40 black steel pipe, ASTM A 53.

B. Copper sleeves: Type L, ASTM B 88 hard drawn.

C. Cast-iron sleeves: Extra heavy, equal to product of U.S. Pipe Co. with waterstop and ends as shown on the drawings.


E. Sealing compound in walls and floors: Equal to the following:

   1. Bare and insulated pipes carrying fluids 150 degrees F (65 degrees C) and below: Sika Corporation “Sikaflex – 1a.” Use a primer for applications required by the manufacturer.

   2. Bare and insulated piping carrying fluids 151 degrees F (66 degrees C) and above: Dow Corning Corporation “795 Silicone.” Use a primer for applications required by the manufacturer.

F. Floor, wall, and ceiling plates for existing piping: Stamped or cast brass with chrome finish and set screw, split and tabbed.

G. Floor, wall, and ceiling plates for new piping: Stamped or cast brass with chrome finish and set screw.
H. Mechanical penetration seals: Equal to PSI “Link-Seal Modular Seals” or Calpico Sealing Link “LINX”. Seals shall be modular mechanical type, consisting of interlocking synthetic links shaped to continuously fill the annular space between the pipe and wall opening. Bolt and nut fasteners for the seals shall be stainless steel for units used in penetrations below grade.

PART 3 - EXECUTION

3.1 INSTALLING SLEEVES

A. Install sleeves for piping, or piping with insulation continuous through sleeve, passing through walls, partitions, beams, or slabs.

B. Do not cut, drill, or burn structural steel for installation of piping without specific instructions from the Architect.

C. Locations in non-fire-rated construction:
   1. Install steel sleeves for penetrations of steel, iron, and insulated piping.
   2. Install copper sleeves for penetrations of uninsulated copper tubing and piping.
   3. Install plastic sleeves for penetrations of plastic piping. Plastic piping and sleeves are not permitted in ceiling spaces used as HVAC system plenums, or in shafts used for building HVAC air distribution.

D. Locations in floors and fire-rated construction: Sleeves used in piping penetrations through fire-rated construction shall be an acceptable component of the through-penetration firestop assembly as specified in Division 07.
   1. Where firestop assembly is UL listed, sleeve material shall be as directed in the listing.
   2. Where other specified approval and acceptance is required, sleeve shall be as described in the approved assembly.

E. Install sleeves through walls and partitions flush with finished surfaces.

F. Sleeves through floors shall extend 0.375 inch (10 mm) above top of finished floor and be finished neat and level. Sleeves through mechanical or equipment room floors shall extend one inch (25 mm) above finished floor. Provide projecting sleeves with anchor clips to prevent them from being loosened and knocked down in the floor construction.

G. Sleeves for insulated piping shall be large enough to pass piping and insulation.

H. Seal spaces between sleeves and pipe, or pipe insulation, in nonrated walls, with mineral wool.
I. Penetrations in exterior masonry or concrete walls and foundations:

1. Sleeves: Cast iron, or in cast concrete may be core drilled.
2. Above grade: Mechanical penetration seal at outside face of wall.
3. Below grade: Mechanical penetration seal, at outside face of wall.

3.2 INSTALLING PLATES

A. Exposed piping passing through interior walls, partitions, floors, and ceilings shall be fitted with plates of size and depth to conceal sleeves. Secure plates firmly in place with set screws.

END OF SECTION
SECTION 22 05 06 - CURBS AND FLASHINGS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe boot assemblies and flashing devices for plumbing items and equipment penetrating roof and mounted on roof.

1.2 RELATED SECTIONS


1.3 SUBMITTALS

A. Shop drawings: Flashing assemblies and devices showing compatibility with roof membrane, insulation, and slope, and configuration for the supported equipment.

B. Product data: Each type of manufactured unit, accessory, and accessory material.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood-preservative-treated lumber: As specified in Section 22 05 00.

1. Application: Treat items indicated on the drawings, and the following:

a. Wood cants, nailers, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.

2.2 PENETRATIONS OF SINGLE PIPE OR VENT

A. Basis-of-design product: Subject to compliance with requirements, provide the specified product, or comparable product by another manufacturer.

B. Plumbing vents through flat roof: Equal to Elmdor/Stoneman 1100-4, 4-lb (1.8 kg per 0.09 sq. m) seamless lead flashing assembly, 8-inch (205-mm) skirt, top counterflashing fitting, and waterproofing compound.

C. Plumbing vents on sloped roofs: Equal to Oatey Flashings type “Hi Collar Lead Flashing” with base size 15 by 15 inch (380 by 380 mm); weight of lead, 4 lbs (1.8 kg per
0.09 sq. m); angle of roof as shown on the drawings. Flashing shall be formed to fit over top of pipe and in one continuous piece down to roof.

D. Boot for water piping through flat roof: Equal to Elmdor/Stoneman 1100-4, 4-lb (1.8 kg per 0.09 sq. m) lead boot, 8-inch (205-mm) skirt; top counterflash fitting and waterproofing compound.

2.3 PENETRATIONS OF GROUPS OF PIPES

A. Basis-of-design product: Subject to compliance with requirements, provide the specified product, or comparable product by another manufacturer.

B. Where a group of pipes penetrates the roof, provide a curb assembly equal to RPS Corporation Style RC. Assembly shall include curb, cover, and boots and clamps for the number of lines shown on the drawing. Curb shall be a minimum of 18-gauge galvanized steel, unitized construction with integral base plate insulated with 3-pound (48 kg/m³) density insulation, 2 by 2 inch (50 by 50 mm) nailer, acrylic-clad ABS plastic cover, and fastening screws. Boots shall be graduated step design EPDM rubber, with stainless-steel lock clamps.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Plumbing vent shall extend 8 inches (205 mm) above finished roof. Clamp devices shall be tightly sealed to vent. Space between vent hub and pipe shall be lightly caulked with lead to provide for movement in piping.

B. Flashing of roofing felts into clamping devices of roof drains and sleeves through roof, and flashing and counterflushing of pipe curb assemblies and of roof rails and curbs shall be as specified under Division 07, including all material and labor to waterproof roof.

C. Where dissimilar metals would come in contact with each other, coat them with bituminous protective coating or other coating compatible with adjacent materials.

END OF SECTION
SECTION 22 05 09 - PLUMBING EXPANSION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precharged bladder-type expansion tank for potable water system.

1.2 RELATED SECTIONS

A. Piping: Section 22 11 16.

B. Supports: Section 22 05 29.

1.3 SUBMITTALS

A. Product data: Each type of expansion system or tank, including each relief and air separation device and all accessories.

   1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

1.4 QUALITY ASSURANCE

A. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

B. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

C. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified and scheduled products, or comparable products by one of the following:

   1. Expansion tanks:
a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell and Gossett Domestic Pump Div of ITT
d. Taco
e. Wessels

2.2 EXPANSION TANK FOR POTABLE WATER

A. Pressurized bladder type tank, Taco PAX model number scheduled on the drawings, containing impermeable bladder which separates the air cushion from the system water. Operating temperature: 240 degrees F maximum. Precharge to manufacturer’s standard pressure.

B. Shell: Welded steel, constructed, tested and stamped in accordance with ASME BPV for Unfired Pressure Vessels for a working pressure of 125 psi. Lined with protective coating.

C. Bladder: Butyl rubber, flexible but not stretchable under working conditions, removable for inspection.

D. FDA approval: Wetted components FDA-approved materials.

E. Size and capacity: Shown on the drawings.

F. Supports: For horizontal or vertical support on concrete equipment foundation, as diagramed on the drawings.

PART 3 - EXECUTION

3.1 INSTALLING EXPANSION TANKS

A. Follow manufacturer’s instructions and recommendations.

B. Install piping, air separation apparatus, and vents as diagramed on drawings.

C. Install supports as shown on drawings.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 22 05 00, provide operating instructions.

END OF SECTION
SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Unless otherwise specified in a particular section or required for a particular application, motors shall conform to the following requirements, whether factory-installed or field-installed.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Motor capacitors: Section 26 05 21, Wiring Connections.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Pumps: Section 22 11 23.

1.4 REFERENCES

A. NEMA MG 1: Motors and Generators.


D. UL 508: Industrial Control Equipment.

1.5 DEFINITIONS

A. Energy efficient motor: Motor meeting the nominal and minimum efficiency levels listed for its horsepower and speed in Table 12-10 of NEMA MG 1.

B. Nominal efficiency: Efficiency as defined in Table 12-8, Efficiency Levels, in NEMA MG 1, and identified on the motor nameplate.
1.6 SUBMITTALS

A. Product data:
   1. Motors and drives not provided with equipment: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lugs, and coatings.

B. Wiring diagrams required for the proper installation of plumbing equipment.

C. Submit product data which verifies compliance with ASHRAE 90.1 or provide certified performance ratings by a qualified independent testing agency.

D. Certifications:
   1. Actual motor power factor for each motor, certified test results for each motor proposed for use on this project.
   2. Field test showing corrected power factor, if required.

1.7 QUALITY ASSURANCE

A. Actual motor power factor shall be tested and certified by an independent testing laboratory.

B. UL label and local testing (if required): As specified in Section 22 05 00, Common Work Results for Plumbing.

C. Plumbing equipment shall meet the energy performance requirements of ASHRAE 90.1.

1.8 REGULATORY REQUIREMENTS

A. Motors shall conform to the requirements of NEMA MG1 and applicable portions of the National Electric Code (NEC, NFPA 70).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Motors:
   1. A.O. Smith
   2. Baldor Electric Co.
   3. Marathon
   4. Rockwell
5. Siemens
6. Toshiba International

B. Motor capacitors:

1. ABB Power Distribution
2. Commonwealth Sprague
3. General Electric

2.2 BASIC MOTOR REQUIREMENTS

A. Capacity: Each motor shall have sufficient capacity and torque to start, accelerate, and operate the machine it drives without exceeding the motor nameplate rating at the speed specified, or at any speed and load which may be obtained by the drive actually furnished.

B. Starting: Each automatically controlled motor shall be capable of starting as frequently as the control sequence may demand. Motors not automatically controlled shall be capable of making no fewer than 4 starts per hour.

C. Loads: Belt-connected motors shall be equipped with shafts and bearings designed to withstand both the normal connected loads of the drive furnished, and momentary loads imposed during acceleration.

D. Ratings: Motors shall be rated for continuous duty at 100 percent of rated capacity, and temperature rise shall be based on ambient temperature of 40 degrees C.

E. Phase: Unless otherwise indicated, motors one-half horsepower and larger shall be polyphase and motors smaller than one-half horsepower shall be single-phase motors.

F. Motor construction:

1. Motors for pumps, unless specified otherwise in the equipment section, shall be open drip-proof NEMA design B construction.

G. Efficiency: The term “energy efficient” is defined in the article “Definitions” in Part 1 above.

1. Single-phase motors, alternating-current fractional horsepower, rated 1/20 to 1 horsepower, 250 volts or less: NEMA MG 11, types and efficiencies selected for their applications.
2. Polyphase motors, medium alternating-current, squirrel-cage, 1 to 500 horsepower, 600 volts or less: NEMA MG 10, energy-efficient types selected for their application. Nominal full-load efficiencies shall meet or exceed ratings of Table 12-10 of NEMA MG 1.
2.3 SINGLE-PHASE MOTORS

A. Permanent split-capacitor or split-phase type.

B. Bearings: Sealed, prelubricated ball-bearing type.

2.4 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Brushless direct current (DC) variable speed motor supplied with alternating current, with a permanent magnet with near zero rotor losses, permanently-lubricated ball bearings, electronic commutation, designed for synchronous rotation, and at least 70% efficient at all operating speeds.

B. As a minimum, the motor shall include the following features:

1. Integrated controller / inverter that operates the wound stator and senses rotor position to electronically commutate the stator.
2. Thermal overload protection.
4. Inductors to minimize harmonic distortion and line noise.
5. Designed to overcome reverse rotation without affecting life expectancy.
6. Include a pulse width modulating (PWM) controller for either manual or DDC controlled motor speed adjustment down to 25 percent of full speed. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM shall be capable of receiving a 0-10Vdc analog signal from a DDC controller provided by the controls contractor, as indicated or required by other sections of DIV 23 specifications.
7. Software for motor control as indicated or described in other DIV 22 specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount direct-connected motors securely and in accurate alignment. The drive shall be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

B. Provide each belt-connected motor with a securely mounted adjustable base to permit installation and adjustment of belts.
C. Mount capacitors shipped separately beside motor connection box as required. Connect in accordance with the requirements of Division 26, Electrical.

1. Test units at full rated load after the installation of the motor capacitors, and submit reports.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 22 05 00, provide operating instructions.

END OF SECTION
SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Meters and gauges for plumbing systems.

1.2 RELATED SECTIONS

A. Pipe installation and testing: Section 22 05 00.

B. Valve tags and charts: Section 22 05 23.

1.3 SUBMITTALS

A. Shop drawings: Meter and gauge schedule showing manufacturer’s figure number, scale range, location, and accessories for each meter and gauge.

B. Product data: For each type of meter, gauge, device, and fitting specified.

1. Scale range.
2. Ratings.
3. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

1.4 QUALITY ASSURANCE

A. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

B. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

C. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Meters and gauges:
1. AMETEK; U.S. Gauge
2. Ashcroft; Dresser Instrument
3. Miljoco Corporation
4. Taco, Inc.
5. H.O. Trerice Co.
6. Weiss Instruments
7. Weksler; Dresser Instrument

B. Pressure-temperature connections:

1. Miljoco Corporation
2. Peterson Equipment Company
3. Sisco
4. Texas Fairfax Company
5. H.O. Trerice Co.
6. Utilities Materials and Controls, Inc.
7. Weiss Instruments

2.2 THERMOMETERS

A. General: Industrial, adjustable angle type, accurate to within plus or minus one percent of range span, baked enamel finish, blue reading organic liquid tube, glass or clear acrylic plastic window, dust and moisture tight.

1. Scale size: 9 inches (230 mm).
2. Graduation: To the scale shown on the drawings or of a scale so that the normal working temperature of the system is near the mid-point of the scale.

B. Pipe-mounted thermometers: Brass well, separable sockets.

1. Where mounted in insulated piping, thermometers shall have six-inch (150-mm) stem length and sockets with 2.5-inch (64-mm) lagging extension necks. Where mounted in uninsulated piping, they shall have 3.5-inch (89-mm) stem lengths and sockets without lagging extension.
2. Where thermometer wells only are required, provide separable socket with 2.5-inch (64-mm) lagging extension, fitted with attached chain and cap.

2.3 PRESSURE GAUGES

A. Pressure gauges shall be accurate to within plus or minus one percent of range span, silver brazed bronze bourdon-tube system, bronze movement, aluminum dial with white background, black graduations and numerals and adjustable pointer, bottom connected.
1. Dial diameter: 6 inches (150 mm).
2. Those installed adjacent to pumps or in pulsating locations shall be provided with pulsating dampeners or snubbers.
3. Case: Cast aluminum or glass filled nylon.

B. Graduation: To the scale shown on drawings or so pointer is nearly straight up at system normal working pressure.

C. Gauges shall be straight pressure type, except gauges on suction side of pumps and inlet side of suction strainers shall be compound type.

D. Gauge cock (pressure gauge isolation valve):
   2. Ball valve: Bronze, three-piece body, full port, with Type 316 stainless steel trim, 150 psi (1034 kPa) saturated steam, 600 psi (4137 kPa) non-shock cold water, oil, or gas, equal to Nibco 595-T-66-LF.

2.4 COMBINATION PRESSURE-TEMPERATURE CONNECTIONS

A. Combination pressure-temperature connections: Equal to UMAC Universal Lancaster Test Plugs, Peterson “Pete’s Plug,” Sisco, Fairfax P/T Plugs, H.O. Trerice test plugs or Miljoco test plugs. Plugs shall have self-closing valve which will operate at a temperature up to 300 degrees F (149 degrees C). Body and cap shall be brass, and shall receive either a temperature or pressure probe. Provide with a kit including gauges and thermometers in a protective case.

PART 3 - EXECUTION

3.1 INSTALLING THERMOMETERS

A. Pipe line thermometers shall be installed as indicated on the drawings.

B. Furnish and deliver to Owner at final inspection, three additional pipe line thermometers as above specified, with 6-inch (152-mm) stem lengths, for use in the thermometer wells. Ranges shall be minus 40 to plus 110 degrees F (minus 40 to 43.3 degrees C.); 20 to 120 degrees F (minus 6.7 to 48.9 degrees C.), and 50 to 550 degrees F (10 to 287.8 degrees C).

3.2 INSTALLING PRESSURE GAUGES

A. Each gauge connection shall have a gauge cock. Connections to pipe lines shall be 0.5 inch (DN 15), with 0.5 inch (DN 15) by 0.25 inch (DN 8) reducer for valve, the assembly of sufficient length to clear insulation.
B. Where gauge cocks only are called for on drawings, provide the 0.5-inch (DN 15) connections to pipe line with reducer and the gauge cock.

C. Provide one compound and one straight pressure gauge of appropriate scale to Owner at final inspection.

3.3 INSTALLING COMBINATION PRESSURE-TEMPERATURE CONNECTIONS

A. Option: Provide combination pressure-temperature connections, complete with kits, where thermometer wells or gauge cocks only are called for on the drawings.

END OF SECTION
SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Valves for various piping systems.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 05 00.


C. Automatically operating valves: Section 22 11 19.

D. Automatic water temperature control valve for domestic hot water: Section 22 11 19.

1.3 REFERENCES

A. ASME B16.10: Face-to-Face and End-to-End Dimensions of Valves.

B. ASME B16.34: Valves - Flanged, Threaded, and Welding End.

1.4 SUBMITTALS

A. Product data: For each type of valve. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

   1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Maintenance data: For inclusion in operation and maintenance manual specified in Division 01 and Section 22 01 01. Include manufacturer's instructions for adjusting, servicing, disassembling, and repairing.

C. Valve charts: Furnish valve charts typed on 8.5 by 11-inch (216 by 279-mm) bond paper, showing locations of all manual and automatic control valves, and flow meters. Include:

   1. Number
   2. Location
   3. Service
   4. Function
   5. Area served
D. Valve numbering system shall be approved by the Owner prior to final submittal. Place one copy of approved chart in a plastic envelope and mount on wall where directed. Provide another copy for each of the Operating and Maintenance Manuals.

1.5 QUALITY ASSURANCE

A. Ferrous valves shall conform to ASME B16.10 and B16.34 for dimension and design criteria.

B. Copper alloy valves (brass and bronze) shall have no more than 15 percent zinc in the alloy.

C. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

D. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements. Product specifications herein may not define all product options necessary to meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Gate valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following:

1. Crane Co.
2. Hammond Valve Co.
3. Lunkenheimer Co.
4. Milwaukee Valve Co.
5. NIBCO
6. Stockham Valve & Fittings
7. Walworth Co.

B. Ball valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following:

1. Apollo Valves
2. Milwaukee Valve Co.
3. NIBCO  
4. Stockham Valve & Fittings  
5. Victaulic Company of America  
6. Walworth Co.  
7. Watts Regulator Co.

C. Check valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following:

1. Combination Pump and Valve Co.  
2. Mueller Steam Specialty  
3. NIBCO  
4. Victaulic Company of America

D. Balancing valves: Subject to compliance with requirements, provide the specified Bell & Gossett valve, or comparable product by one of the following:

1. Watts Regulator Co.  
2. Armstrong

E. Backwater valves: Subject to compliance with requirements, provide the specified swing check valves or Zurn valves, or comparable products by one of the following:

1. Ames Company, Inc.  
2. Jay R. Smith  
3. Jenkins Bros., a corporation  
5. Zurn

F. Hose connections: Subject to compliance with requirements, provide the specified Zurn valves, or comparable products by one of the following:

1. Jay R. Smith  
2. Crane Co.  
4. Woodford Manufacturing Co.  
5. Zurn

G. Drain valves: Subject to compliance with requirements, provide the specified NIBCO valves, or comparable products by one of the following:

1. Apollo Valves  
2. Milwaukee Valve Co.  
3. NIBCO  
4. Stockham Valve & Fittings
5. Victaulic Company of America
6. Walworth Co.
7. Watts Regulator Co.

2.2 VALVES

A. Gate valves:

1. Valves NPS 5 (DN 125) through NPS 12 (DN 300); 300 psi CWP, outside screw and yoke, resilient wedge, epoxy coated interior and exterior, iron body construction. NIBCO F-607-RWS, flanged.

B. Ball valves:

1. Valves NPS 0.25 (DN 8) through NPS 2 (DN 50); 600 psi CWP, two-piece silicon bronze alloy body, full port, blowout-proof stem, PTFE seats, stainless-steel ball and stem. Extension handle for use in insulated piping. NIBCO T-685-66-LF or S-685-66-LF, threaded or soldered ends.

2. Valves NPS 2.5 (DN 65) through NPS 4 (DN 100); 400 psi (27.6 Bar) non-shock cold working pressure, two-piece brass body, full port, blow-out-proof stem, PTFE seats, forged body and end cap, stainless-steel ball and brass stem, extension handle for use in insulated piping, NIBCO T-FP-600A-LF or S-FP-600A-LF, threaded or soldered ends.

C. Check valves:

1. Center-guided, spring-loaded silent-action type check valves: Valves NPS 0.5 (DN 15) through NPS 2 (DN 50); 250 psi CWP, silicone bronze body, PTFE disk, stainless-steel stem and spring, NIBCO T-480-Y-LF or S-480-Y-LF, threaded or soldered ends.

2. Swing check valves: Valves NPS 0.5 (DN 15) through NPS 2 (DN 50); 200 psi CWP, silicone bronze body, PTFE seat, renewable seat and disk, Y pattern, horizontal swing, NIBCO T-413-Y-LF or S-413-Y-LF, threaded or soldered ends.

D. Balancing valves:

1. NPS 3 (DN 80) and smaller: Calibrated balancing valve equal to Bell & Gossett Circuit Setter Plus.

   a. Materials: Low-lead brass body (<0.25 percent lead content), stainless-steel ball with carbon filled TFE seat rings.
   b. Pressure and temperature ports. Differential pressure readout ports across valve seat area.
   c. Ratings (NPT): Entire assembly 400 psi, 250 degrees F (2758 kPa, 121 degrees C).
d. Flow element: Variable orifice flow meter.
e. Adjustable pre-set balancing points with memory stop and isolation valve.
f. Drain port: 1/4-inch NPT.
g. Bi-directional design.
h. Bellows type meter gauge kit with case, provide one for use on the entire project.

E. Backwater valves:

1. Valves:
   a. Valves NPS 1.5 (DN 40) and smaller installed above ground: Swing check valve.
   b. Valves NPS 2 (DN 50) and larger installed above ground: Zurn Z-1090, flapper type.
   c. Valves NPS 2 (DN 50) and larger installed below slab-on-grade: Zurn Z-1095, flapper type with cast-iron floor level cleanout and plug.

2. Service box for backwater valve: Fiberglass-reinforced polymer concrete, modular stacking units equal to Hubbell Power Systems; Quazite Enclosures, PC style, manufacturer's standard gray, enclosures and cover rated to support no less than 8,000 lbs. over a 12 by 12-inch area.
   a. Size: No less than 17 by 30 inches (432 by 762 mm), depths and number of stacked units required for valve location.
   b. Cover: Locking, with two tamperproof stainless-steel bolts, nonskid surface, impressed BWV logo, 1 by 4 inches (25 by 102 mm) pull slot.
   c. Base: Open (no base).
   d. Stone filter material: Uniform gradation, AASHTO M 43 size 67 or 7.

2.3 HOSE CONNECTIONS

A. Exterior wall hydrants:

1. Non-freeze type.
2. ASSE 1019 hydrant with integral anti-siphon backflow preventer.
3. Automatic drain.
4. Flush-mount, bronze casing and interior parts; stainless steel face.
5. Provide operating rod of length to match wall thickness, provide wall clamp.
7. Ceramic disc half turn valve.
8. Key-operated.
9. NPS 0.75 (DN 20) inlet.
10. NPS 0.75 (DN 20) ASME B1.20.7 garden-hose thread outlet.
11. Equal to Zurn Z-1321XL.
B. Hose bibs:

1. Provide with factory installed ASSE 1011 hose connection vacuum breaker.
2. Bronze body, stem, and bonnet, chrome-finished where exposed and rough brass where concealed. Provide metal handle as well as operating key. Remove handle for key operation where hose bib is accessible to the general public. Leave metal handle in place where concealed.
4. Compression type valve with replaceable washer.
5. Key or handle operated.
6. NPS 0.75 (DN 20) inlet.
7. NPS 0.75 (DN 20) ASME B1.20.7 garden-hose thread outlet.
8. Equal to Zurn Z-1341-CM.

2.4 DRAIN VALVES

A. Drain valves:

1. Provide with supplemental ASSE 1011, backflow preventer.
2. Full-port, two-piece ball valve, bronze body, bronze ball, replaceable PTFE seats and seals, vinyl-covered steel handle, threaded or soldered inlet, threaded cap with brass chain. Provide extension handles where used in insulated piping. Remove handle where valve is accessible to the general public.
3. Pressure rating: 600 psig (4137 kPa)
4. NPS 0.75 (DN 20) inlet.
5. NPS 0.75 (DN 20) ASME B1.20.7 garden-hose thread outlet.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install valves to be readily accessible for operation and maintenance, and with ample clearance for turning handles or operators.

B. For valves in inaccessible locations, provide access doors as specified in a related section.

C. Identify valves as specified in Section 22 05 00, Common Work Results for Plumbing.

1. Provide tags for all valves except stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.
2. Provide ceiling identification tags where valves are above an accessible suspended ceiling. Number shall correspond to tag number.
3.2 INSTALLING GATE VALVES AND BALL VALVES

A. Install shutoff valves for water piping where indicated.

1. Sizes NPS 4 (DN 50) and smaller: Ball valves.
2. Sizes NPS 5 (DN 130) and larger: Gate valves.

3.3 INSTALLING CHECK VALVES

A. Provide center-guided, spring-loaded silent-action type check valves in domestic water lines.

B. Provide swing-type check valves in sanitary, storm, and clear water waste lines.

3.4 INSTALLING BALANCING VALVES

A. Install balancing valves where indicated.

B. Locate valve to provide a minimum of 5 pipe diameters straight inlet and 2 pipe diameters straight outlet.

3.5 INSTALLING BACKWATER VALVES

A. Valve: Provide backwater valves in plumbing drainage piping where indicated.

B. Service box: Where shown on drawings, install service box with bottom unit resting on stone filter material no less than two inches deep. Follow box manufacturer's instructions, including installation of deep unit at bottom of stacked units.

3.6 INSTALLING HOSE CONNECTIONS

A. Wall hydrants: Provide wall hydrants where indicated.

B. Hose bibs: Provide hose bibs where indicated. In finished areas, locate units so that domestic water connection is concealed inside adjoining partition or furred space.

C. Drain valves: Provide drain valve at every low point of a water system, and where indicated.

3.7 INSTALLING DRAIN VALVES

A. Provide drain valve at every low point of a water system, and where indicated.

END OF SECTION
SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe hangers and supports.

B. Equipment foundations and supports.

C. Accessories.

1.2 RELATED SECTIONS

A. Vibration control supports: Section 22 05 48.

1.3 REFERENCES

A. ASME B31.9: Building Services Piping.


1.4 DEFINITIONS

A. Definitions are from MSS SP-58, “Classification of Piping Systems.”

B. Hot Systems: Maximum operating (service) temperatures 120 degrees F (49 degrees C) and above.

C. Ambient Systems: Maximum operating temperatures 60 to 119 degrees F (16 to 48 degrees C).

D. Cold Systems: Maximum operating temperatures 59 degrees F (15 degrees C) and below.

1.5 SUBMITTALS

A. Product data: Provide manufacturer’s literature showing compliance with specifications for each type of hanger and manufactured support, including fasteners and accessory materials.
1. For supports used as components of fire protections systems, include certification of listing and label as required in “Quality Assurance” below.

1.6 QUALITY ASSURANCE

A. Hangers and supports shall comply with the requirements of:

1. MSS SP-58.
2. ASME B31.9.

B. Hangers and supports used as components of fire protection systems shall:

2. Be listed and labeled by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7.

C. Qualifications of welders: As specified in Section 22 05 00, Common Work Results for Plumbing.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Pipe hangers:

1. Anvil International
2. Carpenter and Paterson, Inc.
3. National Pipe Hanger Corporation
4. PHD Manufacturing, Inc.
5. PHP Systems/Design

B. Support systems:

1. Anvil International
2. PHD Manufacturing, Inc.
3. PHP Systems/Design
4. Unistrut

C. Thermal hanger shields:

1. Carpenter and Patterson, Inc.
2. Pipe Shields, Inc.
3. Rilco Manufacturing Co., Inc.

2.2 CONCRETE
A. Concrete shall be no less than 3000-lb (25,000 kPa) strength.

B. Reinforcement: 6 by 6 inch (150 by 150 mm) welded steel wire fabric, ASTM A 185.

2.3 GROUT

A. Non-shrink grout: Premixed, consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi (48,000 kPa) in 28 days.

1. Sonneborn-Rexnord “Sonogrout”
2. L&M Construction Chemical Company “Crystex”
3. US Grout Corporation “Five-Star Grout”

2.4 PIPE HANGERS AND SUPPORTS

A. Types are identified by MSS type numbers in the article Installing "Pipe Hangers and Supports" below.

B. Materials for hangers and clamps:

1. For copper pipe: Copper plated.
2. For steel, insulated, and cast-iron pipe: Galvanized in crawl spaces, tunnels, or wet areas; galvanized or factory-painted in other areas.

C. Insulating-insert materials and protection shields:

1. Insulation-insert material for cold piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa); or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier. Insert thickness shall match adjacent piping insulation thickness.

2. Insulation-insert material for hot piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa); ASTM C 552, Type II cellular glass with 100-psig (688-kPa); or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.

3. Insert and shield shall cover entire circumference of pipe.
4. Insert length: Extend 2 inches (50 mm) beyond shield.

D. Pipe covering protection saddle: Steel, meeting requirements of MSS SP-58 Type 39, with insulating material located in the space between saddle and pipe.

E. Hanger rod nuts and washers shall be zinc-plated. Hanger rods shall be solid steel, all threaded, and zinc-plated.
F. Channel: Slotted cold-rolled steel, equal to Power Engineering Company PS 150 S, 12 gauge with 0.406- by 3-inch (10 by 76-mm) slots on 4-inch (102-mm) centers.

G. Wall- and floor-mounted supports: Structural support system equal to Power Engineering Company "Power Strut."

H. Structural shapes: ASTM A 36.

I. Steel pipe: ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40, black and galvanized steel.

J. Threaded rod: MSS SP-58.

2.5 FASTENERS

A. Fasteners to concrete: Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes, equal to ITT Phillips Anchors “Red Head.” Fasteners to ceilings shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer’s stated load capacity in 3500 psi (24,000 kPa) concrete.

B. Fasteners to drywall or cavity wall construction: Equal to ITT Phillips Anchors “Red Head” toggle bolts, with hollow wall drive anchors or nylon anchors as required.

C. Fasteners to wood construction: Lag bolts.

D. Bolts, nuts, and washers: ASTM A 307, or ASTM A 325 where high strength is required.

PART 3 - EXECUTION

3.1 INSTALLING PIPE HANGERS AND SUPPORTS

A. Types and locations, refer to MSS SP-58:

Type 1 Clevis hanger:

1. Hot Systems NPS 0.5 (DN 15) through NPS 8 (DN 200).
2. Ambient Systems and Cold Systems of all sizes.

Type 8 Riser clamp, steel for steel or cast-iron risers and stacks, copper plated for copper risers and stacks.

Type 9 Adjustable band hanger for piping up to NPS 8 (DN 200) size. Copper-plated for use with uninsulated copper piping up to NPS 4 (DN 100) size.
Type 10  Copper plated adjustable swivel ring for uninsulated copper piping NPS 0.5 (DN 15) through NPS 4 (DN 100). Use Type 1 for insulated pipe.

Type 18  Malleable iron concrete inserts for supporting hangers from concrete structure.

Type 20  Side beam clamp for attaching hanger rods to structural beams. Use proper size clamp to suit beam flange.

Type 23  C-clamp for beams with maximum flange thickness of 0.75 inch (19 mm); for use with single pipes NPS 2 (DN 50) and smaller.

Type 33  Heavy welded steel bracket capable of supporting up to 3,000 lbs (1360 kg), with a Type 9 or Type 1 hanger for piping along walls.

Type 34  Side beam bracket for storm water and sanitary lines running along walls or fastened to sides of wood beams, for pipe up to NPS 4 (DN 100).

Type 37  Adjustable pipe stanchion saddle with U-bolt and floor flange anchored to floor, for piping NPS 2 to 12 (DN 50 to 300) supported from floor.

Type 39  Pipe-covering protection saddle for use between roller-type hangers and Hot System piping.

Type 40  Pipe-covering protection shield of proper size to fit insulation, between hanger and insulation:

1. Size to fit pipe, between hanger and plastic piping.
2. Include structural insulation insert between protection shield and pipe for piping NPS 2.5 (DN 65) and larger.
3. Option: Instead of protection shield and structural insert, provide thermal hanger shield.

Type 41  Cast-iron roll and sockets, steel roll rod:

1. Supported from above: Hot Systems NPS 8 (DN 200) and larger. Include hanger bolts.
2. Supported from below: Provide continuous thread rods and hex nuts for piping NPS 8 (DN 200) and larger where adjustable support is required.

Type 44  Cast-iron roll, steel roll rod, provided with steel chair, bolts, and hex nuts, for pipe in racks and at fixed structural supports such as brackets, where no vertical adjustment is required.
B. Trapeze piping supports:

1. Field-fabricated from ASTM A 36 steel shapes.
2. Weld steel according to AWS D-1.1.
3. Size threaded rods in accordance with MSS SP-58.
4. Design trapeze support assembly based on supported load plus a 50 percent safety factor.

C. For hangers requiring vibration control, see Section 22 05 48.

D. Hanger rod sizes:

<table>
<thead>
<tr>
<th>PIPE SIZE NPS (DN)</th>
<th>ROD SIZE Inches (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2 (Up to 50)</td>
<td>0.375 (10)</td>
</tr>
<tr>
<td>2.5 to 3.5 (65 to 90)</td>
<td>0.5 (15)</td>
</tr>
</tbody>
</table>

E. Horizontal piping generally shall be supported from above.

1. Attaching to walls: Use two 0.375-inch (9.5-mm) screw-type fasteners for attaching brackets and three 0.5-inch (13-mm) bolt-type fasteners for attaching structural supports.

2. Attaching to bar joists:
   a. Pipes NPS 2.5 (DN 65) and smaller running parallel with joist: Hanger rods welded to top chord of joist at panel points.
   b. Pipes NPS 2.5 (DN 65) and smaller running perpendicular to joist: Support from every other joist by method of hanging as described above.
   c. Pipes NPS 3 (DN 80) and larger running parallel with joist: Support from a length of structural channel or angle welded to the top cords of at least two joists at panel points.
   d. Pipes NPS 3 (DN 80) and larger running perpendicular to joist: Support from every joist by hanger rods welded to top chord of joist at panel points.
   e. Where large numbers of pipes are grouped together, their individual hangers shall be staggered so as to distribute the load among the available joists.

3. Attaching to concrete slab: Secure hanger rods to malleable iron inserts properly spaced and set on the forms before concrete is poured.
4. Attaching to steel decks: Attach hanger rods to the hanger tabs on underside of deck, or pass them through the steel deck and secure on top side with nut, locknut and plate washer.
h. Plate washers: 4 by 8 inches by 0.125 inch thick (100 mm by 200 mm by 6 mm) for 0.375-inch and 0.5-inch (10 mm and 15 mm) rods; 6 by 12 inches by 0.187 inch (150 by 305 by 5 mm) thick for 0.625-inch (16-mm) and larger rods.

b. Top of hanger assembly shall be concealed in the concrete fill which will be placed over the deck.

5. Attaching to precast concrete plank: Hanger rods shall pass through the plank and be secured on topside with nut, locknut, and plate washer.

a. Plate washers: 4 by 8 inches by 0.125 inch thick (100 mm by 200 mm by 6 mm) thick for 0.375-inch and 0.5-inch (10-mm and 15-mm) rods; 6 by 12 inches by 0.187 inch (150 by 305 by 5 mm) for 0.625-inch (16-mm) and larger rods.

b. Top of hanger assembly shall be concealed below roof insulation which will be placed over the plank.

c. Where several pipes are running parallel, their individual hangers shall be staggered so as not to concentrate the load on a single plank.

d. Drill openings through precast planks for the passage of hanger rods with power-driven carbide-tip drills, in accordance with Architect’s instructions. Do not cut reinforcing bar without specific approval of the Structural Engineer.

6. Attaching to metal grating:

a. Piping NPS 2 (DN 50) and smaller running perpendicular with secondary members supporting grating: Attach hanger rods to the secondary members using Type 23 clamps. Hanger rods shall have locknuts.

b. Piping NPS 2 (DN 50) and smaller running parallel with secondary members: Attach hanger rods to 2.5 by 2.5 by 0.25-inch (90 by 90 by 8-mm) angles, 12 inches (305 mm) long, that are securely welded to the underside of the grating.

c. Piping NPS 2.5 (DN 65) and larger: Support as specified above for bar joist construction.

7. Attaching to wood roof trusses: Follow roof truss manufacturer’s recommendations for attachment locations, loads, spacing, and methods of attachment.

F. Hangers and supports shall be spaced as follows:

1. Copper pipe:

   a. NPS 1.25 (DN 32) and smaller: At least every 6 feet (1.8 m).
   b. NPS 1.5 and 2 (DN 40 and 50): At least every 8 feet (2.4 m).
   c. NPS 2.5 (DN 65) and larger: At least every 10 feet (3 m).
2. Steel pipe:
   a. NPS 1 (DN 25) and smaller: At least every 6 feet (1.8 m).
   b. NPS 1.25 and 1.5 (DN 32 and 40): At least every 9 feet (2.7 m).
   c. NPS 2 to 6 (DN 50 to 150): At least every 10 feet (3 m).
   d. NPS 8 to 12 (DN 200 to 300): At least every 14 feet (4.3 m).
   e. NPS 14 (DN 350) and over: At least every 20 feet (6.1 m).

3. Cast-iron pipe:
   a. Where joints occur 5 feet (1.5 m) or less apart: At least every 5 feet (1.5 m).
   b. Where joints occur over 5 feet (1.5 m) apart: At least every 10 feet (3 m).

4. Cast-iron no-hub pipe: Support within 18 inches (460 mm) of each horizontal joint. Maximum space between hangers: 5 feet (1.5 m).

5. Plastic pipe with solvent cement or thermal-bonded joint:
   a. NPS 2 (DN 50) and smaller: At least every 3 feet (0.9 m) when line carries liquid; for vent, 6 feet (1.8 m).
   b. NPS 2.5 (DN 65) and larger: At least every 4 feet (1.2 m) when line carries liquid; for vent, 8 feet (2.4 m).
   c. Provide protection shield between hanger and plastic pipe at each support point.

6. Trapeze hangers:
   a. Spacing shall not exceed the requirements for the smallest pipe in the rack.
   b. For wood roof trusses, at least every 6 feet (1.8 m).

G. Cast-iron no-hub pipe:
   1. Tighten bands alternately and firmly with a torque wrench to 60 lbs. (265 N) of torque.
   2. Provide piping NPS 6 (DN 150) and larger and all storm piping with buttresses or tie rods at each change in direction.
   3. Brace horizontal piping against horizontal movement; secure closet bends, traps, and similar items against movement in any direction.
   4. Secure vertical piping at the stack base and at each floor.

H. Provide additional hangers or supports for concentrated loads such as flanges, valves, expansion compensators, fittings, and other specialties.

I. Provide hangers as required for insulated piping systems. Coordinate selection of hangers and supports with requirements and selected options for insulation continuous through hanger or butted to each side. Provide pipe covering protection shield and structural insulation insert where insulation is continuous through hangers or supports.
J. Provide pipe risers through floor slabs with riser clamps.

K. Support PVC vertical risers at each floor and midway between floors.

L. Support banks of pipes along the wall on a structural support system.

M. Provide hanger to support horizontal storm drainage piping within 12 inches of the first fitting downstream of connections to roof drains and overflow roof drains.

3.2 INSTALLING EQUIPMENT FOUNDATIONS AND SUPPORTS

A. Provide four-inch (100-mm) -high concrete foundations (housekeeping pads), reinforced with welded-wire fabric, for floor-mounted equipment and where indicated. Anchor concrete foundations by dowels inserted into the floor slab.

B. Unless otherwise specified, provide concrete foundations, bolts, sleeves, and appurtenances as work of the section where the supported equipment is specified and in accordance with the requirements of Division 03.

C. Equipment shall be properly aligned and leveled, and grouted where necessary. Support piping independently of equipment and so as not to cause a strain or thrust.

D. Coordinate exact size, configuration and location of equipment, foundations, and supports using approved shop drawings of equipment.

END OF SECTION
SECTION 22 05 48 - VIBRATION CONTROL SUPPORTS FOR PLUMBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vibration control supports for plumbing equipment.

1.2 RELATED SECTIONS

A. Hangers and supports: Section 22 05 29.

1.3 SUBMITTALS

A. Product data: For each type of vibration control support included in the work.

B. Shop drawings: Custom-fabricated supports.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Mason Industries product, or comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control
3. Mason Industries
4. Vibro-Acoustics
6. Vibration Mountings and Controls, Inc.

2.2 VIBRATION CONTROL SUPPORTS

A. Provide engineered supports for equipment and locations shown on drawings and specified in Part 3 below. The units shall prevent the transmission of vibration and mechanically transmitted sound to the building structure.

1. Select units in accordance with the weight distribution of the equipment, so as to produce reasonably uniform deflection. Deflections shall be as specified.

B. Specification E: Equal to Mason Industries Type PC30N hangers, combination spring and minimum 0.3-inch (8-mm) deflection neoprene in series and with adjustment to
transfer load to spring while holding supported object at fixed elevation. Include spring deflection indicator.

1. Neoprene element: Molded with a rod isolation bushing that passes through the hanger box.
2. Spring diameters and hanger box lower hole sizes: Large enough to permit the hanger rod to swing through a 30-degree arc before contacting the edges of the hole.
3. Springs shall have a minimum additional travel to solid equal to 50 percent of rated deflection.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Adjust vibration control supports as recommended by manufacturer to eliminate transmission of vibration to building structure or other systems.

B. Replace springs that become permanently deformed with new springs.

C. Provide 0.25-inch (6-mm) structural plate sized as required between isolator and equipment.

3.2 IN-LINE PUMP VIBRATION CONTROL

A. Provide Specification E vibration control supports.

3.3 VIBRATION CONTROLS ON PIPING

A. Piping: Provide Specification E vibration control supports in first three hangers at both the suction and discharge of pumps-air compressors, and vacuum pumps. The static deflection shall be the same as specified for the mountings under the connected equipment.

1. If piping is connected to equipment mounted on slab on grade and hangs from structure under occupied spaces, the first three hangers shall have at least 0.75 inch (19 mm) deflection for pipe sizes up to and including NPS 3 (DN 80), 1.5 inch (38 mm) deflection for pipe sizes up to and including NPS 6 (DN 150) and 2.5 inch (64 mm) deflection thereafter.
2. Other hangers and mounts shall have a minimum spring deflection of 0.75 inch (19 mm).
3. Locate vibration control supports in hanger rods as close to the overhead supports as practical. On supports with double rods, use two vibration control supports.

END OF SECTION
SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Definitions and general requirements applicable to the insulation systems specified in “Related Sections.”

1.2 RELATED SECTIONS

A. Plumbing piping insulation: Section 22 07 19.

1.3 REFERENCES


B. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials

C. UL 723: Standard for Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Concealed insulation shall include work:

1. Above ceilings.
2. Where furred in and in pipe chases.

B. Exposed insulation shall include work:

1. In all rooms and areas.
2. In mechanical equipment rooms, penthouses, or other similar utility spaces.
3. In storage rooms.

C. Unconditioned areas: Areas outside of the insulated envelope.

D. Finished spaces: Areas of the building accessible to the public and to building occupants other than service personnel.

1.5 QUALITY ASSURANCE

A. Perform work in strict accordance with the building, fire and safety codes of the state,
county or city in which the work is performed.

B. Insulation, including fittings and butt strips, jackets, facings, and accessories such as adhesives, mastics, cements, tapes and cloth, shall have a fire and smoke hazard rating and label as tested by ASTM E84, NFPA 255, and UL 723, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50.

C. All insulation and accessories shall be free of asbestos.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation and accessory products in manufacturers’ wrapping or cartons, identified on the exterior and bearing labels showing conformance to flame and smoke rating requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to sections listed in “Related Sections.”

PART 3 - EXECUTION

Not Used.

END OF SECTION
SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing piping insulation for the interior piping systems listed in the minimum insulation thickness schedule at the end of this section.

B. Plumbing piping insulation for the exterior piping systems.

1.2 RELATED SECTIONS

A. Firestopping: Division 07.

B. Painting: Division 09.

C. Definitions and general insulation requirements: Section 22 07 00.

D. Pipe hangers and protection shields: Section 22 05 29.

E. Lavatory piping insulation: Section 22 42 00.

1.3 REFERENCES

A. American Society of Testing and Materials

1. Standards for mineral fiber insulation materials

b. ASTM C 547: Mineral Fiber Pipe Insulation.
c. ASTM C 553: Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

2. Standards for flexible elastomeric insulation materials

a. ASTM C 534: Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

3. Standards for all insulation materials
a. ASTM C 450: Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.


4. Standards for field applied jackets and accessories

a. ASTM C 1729: Standard Specification for Aluminum Jacketing for Insulation


c. ASTM B 209: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer’s name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer’s instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article “Product Options” in Section 22 01 01.
B. Mineral fiber insulation:
   1. CertainTeed Corporation.
   2. Johns Manville
   3. Knauf Fiber Glass GmbH
   4. Owens-Corning

C. Flexible elastomeric insulation:
   1. Aeroflex USA
   2. Armacell LLC
   3. K-Flex USA
   4. Rubatex

D. Coatings, adhesives, and fabrics:
   1. Childers
   2. Foster
   3. Manville Building Materials Group
   4. Rock Wool Manufacturing Company
   5. Trimac

2.2 MINERAL FIBER INSULATION MATERIALS

A. Mineral fiber preformed pipe insulation: Glass fibers bonded with a thermosetting resin, ASTM C 547 Type I, with factory-applied ASJ-SSL jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. ASJ-SSL jacket:
   1. All service jacket with self-sealing lap
   2. White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip
   3. Complying with ASTM C 1136, Type I.

C. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, pressure sensitive, complying with ASTM C 1136; 3 inch (75 mm) width. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

D. Mineral fiber blanket insulation: Glass fibers bonded with a thermosetting resin, ASTM C 553, Type IV, without facing. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
E. Mineral fiber preformed fitting and valve covers: Glass fibers bonded with a thermostetting resin, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

F. Mineral fiber insulation adhesive:

1. Solvent free, low VOC, water-based adhesive designed for bonding mineral fiber insulation to steel or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Foster 85-60 “Quick-Tack”.

G. Mineral fiber insulation vapor barrier mastic:

1. Vapor barrier coating for use over ASJ jackets to give a vapor barrier seal at joints, laps and punctures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Foster 30-65 “Vapor-Fas”.

H. Insulating cement: Mineral fiber cement with a hydraulic-setting binder, conforming to ASTM C 449. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

2.3 FLEXIBLE ELASTOMERIC INSULATION MATERIALS

A. Flexible elastomeric preformed pipe insulation: Closed-cell, sponge- or expanded-rubber, ASTM C 534, Type I for tubular materials. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. Flexible elastomeric preformed fitting and valve covers: Closed-cell, sponge- or expanded-rubber, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
C. Flexible elastomeric insulation adhesive:

1. Water resistant contact cement designed especially suited for bonding two impermeable surfaces and recommended for rubber foam, steel, or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Foster 85-75 “Drion”.

D. Flexible Elastomeric Tape: Black, closed cell, self-adhering, elastomeric thermal insulation tape for insulating pipes and fittings, 0.125 inch (3 mm) thick, 2 inches (50 mm) wide, ASTM C 534, Type I — Grade 1. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

E. Flexible elastomeric insulation vapor barrier coating:

1. Water-based latex enamel coating for use over flexible elastomeric insulation, providing a moisture-resistant protective finish suitable for both indoor and outdoor applications. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Armacell “WB Armaflex” latex enamel.

2.4 FASTENERS

A. Aluminum bands: ASTM B 209, 0.75 inches (19 mm) wide and 0.020 inches (0.4 mm) thick.

2.5 FIELD-APPLIED JACKETS

A. Polyvinyl chloride (PVC) jacket:

1. Jacket material: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Color: White
3. Adhesive: As recommended by jacket material manufacturer. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
4. Fitting covers: Manufacturer’s factory-fabricated fitting covers made from the same material, finish, and thickness as the jacket, suitable to the size of fittings and thickness of insulation. Provide factory fabricated fitting covers for elbows, tees, flanges, unions, reducers, end caps, valves, and other fittings. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
5. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket and fitting covers with acrylic adhesive; suitable for indoor and outdoor applications, 2 inch (50 mm) width, 6 mil (0.15 mm) thickness. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. Canvas jacket:

1. Jacket material: 8 ounces per square yard (270 grams per square meter), fire-retardant treated.
2. Lagging adhesive:
   
   a. Polyvinyl acetate water-based adhesive and coating used indoors to adhere and size canvas over pipe insulation, and able to be top coated with solvent-based paints. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
   
   b. Equal to Foster 81-42W “Lagfas”.

3. Lagging finish coating:
   
   a. Washable, abrasion-resistant, indoor insulation coating for canvas. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
   
   b. Equal to Foster 30-36 “Sealfas”.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Fabric-reinforcing mesh:

1. Woven Glass-Fiber Fabric: Approximately 2 ounces per square yard (68 grams per square meter) for covering pipe and pipe fittings.

2.7 FIELD-APPLIED GLASS CLOTH

A. Glass cloth: Woven Glass-Fiber Fabric: MIL-C-20079H. Type I, plain weave, 8 ounces per square yard (270 grams per square meter).

B. Glass cloth tape: Type II, Class 3, 4.5 ounces per square yard (150 grams per square meter).

C. Lagging finish coating:

1. Washable, abrasion-resistant, indoor insulation coating for glass lagging cloth. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Foster 30-36 “Sealfas”.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide interior piping insulation in accordance with the Minimum Insulation Thickness Schedule for Interior Applications at the end of this section, as modified by specifications for each location and type.

B. Provide field applied jackets in accordance with the Field-Applied Jacket Schedule at the end of this section, as modified by specifications for each location and type.

C. Provide mineral fiber insulation unless otherwise indicated.

D. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer’s printed instructions.

E. Maintain a continuous vapor barrier on systems that convey fluid at below-ambient temperatures, including the following applications:

1. Domestic cold water piping
2. Storm water piping
3. Roof drain bodies
4. Sanitary piping receiving air-conditioning condensate
5. Floor drain bodies receiving air-conditioning condensate
6. Air-conditioning condensate piping
7. Sump pump discharge piping

F. Where a continuous vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

G. Installation at pipe hangers:

1. Insulation shall be continuous through hangers for all piping systems.
2. Install pipe covering protection shields with thickness of structural insulation inserts equal, under load, to that of adjoining insulation.
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.
5. Shields and structural insulation inserts are specified in Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment.
H. Where insulated piping systems pass through sleeves or openings in partitions and floors, the insulation shall be continuous through the sleeves and openings. See Firestopping specifications for coordinating insulation and firestopping.

I. Do not insulate chrome-plated piping connections to plumbing fixtures, except wheelchair-accessible lavatories shall be insulated with special insulation and finish assemblies specified in Section 22 42 00.

J. 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.

K. 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.

L. Install insulation with longitudinal seams at top and bottom of horizontal runs.

M. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

N. Install insulation with least number of joints practical.

O. Finish installation with systems at operating conditions. Repair separations and cracking caused by thermal movement.

3.2 INSTALLING MINERAL FIBER INSULATION

A. Install insulation with factory-applied jackets as follows:

1. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive.
2. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
3. Cover circumferential joints and longitudinal seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
4. Where a continuous vapor barrier is indicated, apply vapor-barrier mastic on longitudinal seams and circumferential joints and at ends adjacent to pipe flanges and fittings.
5. Repair damaged insulation jackets by applying same jacket material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere and seal patches.
B. 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 using mineral fiber preformed fitting and valve covers whenever possible. Install preformed fittings with adhesive. Coat with mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
3. Where mineral fiber preformed fitting and valve covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces 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. Coat with mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
4. Valves: Insulate up to and including the bonnets, stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
5. Strainers: Insulate so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.
6. Flanges and unions: Install preformed pipe insulation to outer diameter of flange or union. Make width of insulation section same as overall width of union or flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange or union insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
7. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

C. Installation of floor drain bodies that receive air-conditioning condensate and roof drain bodies:

1. Provide mineral fiber blanket insulation, 1 inch thick minimum, adhered to drain body.
2. Coat with mastic.
3. Finish with two coats of lagging finish coating with glass cloth and tape embedded between coats.

3.3 INSTALLING FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and circumferential joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
B. Installation on fittings and flanges:

1. Install insulation over fittings and flanges with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate using flexible elastomeric preformed fitting covers whenever possible. Install preformed fittings with adhesive. Tape and seal with vapor barrier coating.
3. Where flexible elastomeric preformed fitting covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces and bonded with adhesive. Tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
4. Flanges: Install pre-formed pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. 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. Secure insulation to flanges and tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
5. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

3.4 INSTALLING FIELD-APPLIED JACKETS

A. Installing PVC jacket:

1. Provide jacket tight to insulation.
2. Provide with 1-inch (25-mm) overlap at longitudinal seams and circumferential joints.
3. For horizontal applications, install with longitudinal seams along top and bottom of pipes.
4. Seal with manufacturer’s recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under the jacket lap and another finish bead along each seam and joint edge.
5. Seams and joints shall completely prevent the entrance of water.

B. Installing canvas jacket: Adhere canvas jacket with lagging adhesive. Finish with lagging finish coating, ready for painting.
3.5 SCHEDULES

A. Minimum insulation thickness schedule for interior applications:

<table>
<thead>
<tr>
<th>Application</th>
<th>Fluid Temperature Range</th>
<th>All Pipe Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Hot Water &amp; Domestic Hot Water Return Piping (2)</td>
<td>105°F to 140°F (40°C to 60°C)</td>
<td>1.5-inch (38 mm)</td>
</tr>
<tr>
<td>Domestic Cold or Tempered Water Piping (1)</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
<tr>
<td>Horizontal Storm Water Piping</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
<tr>
<td>Vertical Storm Water Piping Within 5 Feet (1.5 metres)</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
<tr>
<td>of Floor Slab on Grade (1)</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
<tr>
<td>All Storm Water Piping Receiving Air-Conditioning Condensate (1)</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
<tr>
<td>Roof Drain Bodies</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
<tr>
<td>Sanitary Piping Receiving Air-Conditioning Condensate (1)</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
<tr>
<td>Floor Drain Bodies Receiving Air-Conditioning Condensate</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
<tr>
<td>Air-conditioning Condensate Piping, Gravity and Pumped (1)</td>
<td>--</td>
<td>1-inch (25 mm)</td>
</tr>
</tbody>
</table>

(1) - Contractor’s Option within partitions only: 0.5-inch (13mm) flexible elastomeric insulation.

(2) - Contractor’s Option within partitions only: 1-inch (25 mm) flexible elastomeric insulation for piping NPS 1.25 (DN 32) and smaller.

(3) - See additional specified thickness requirements for exterior applications.

(4) – Insulate where fluid conveyed is below ambient temperature, including but not limited to storm water, ground water, and air conditioning condensate.

B. Field-applied jacket schedule:

<table>
<thead>
<tr>
<th>Application</th>
<th>PVC Jacket</th>
<th>Canvas Jacket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe insulation exposed in mechanical rooms, penthouses, and other service areas not accessible to the public.</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Domestic cold water piping.
B. Domestic hot water piping.
C. Recirculated hot water piping.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 05 00.
B. Trenching: Section 22 05 01.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B 16.18: Cast Copper Alloy Solder Joint Pressure Fittings
2. ASME B 16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASME B16.24: Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

B. American Society of Mechanical Engineers/American National Standards Institute

1. ASME/ANSI B16.1: Cast iron pipe flanges and flanged fittings
2. ASME/ANSI B16.5: Pipe flanges and flanged fittings

C. American Society of Testing and Materials

1. ASTM A 182: Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
2. ASTM A 240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
5. ASTM A 536: Standard Specification for Ductile Iron Castings
6. ASTM B 75: Standard Specification for Seamless Copper Tube
7. ASTM B 88: Standard Specification for Seamless Copper Water Tube

8. ASTM B 584: Standard Specification for Copper Alloy Sand Castings for General Applications

D. American Water Works Association

1. AWWA C-104: American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. AWWA C-110: American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
4. AWWA C-151: American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water

E. National Sanitation Foundation/American National Standards Institute

1. NSF/ANSI 61: Drinking Water System Components – Health Effects
2. NSF/ANSI 372: Drinking Water System Components – Lead Content

1.4 DEFINITIONS

A. Domestic water system: Potable water system for general human use, including hot and cold water supply and return.

1.5 SUBMITTALS

A. Product data: Each type of pipe and fitting included in the project.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Submit proposed method for providing electrical continuity at pipe joints in water service pipe.

C. Submit proposed means for anchoring pipes at water service entrance.

D. Certifications: Disinfection test report

E. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.
1.6 QUALITY ASSURANCE

A. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

B. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

C. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

D. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label directly on the pipe, indicating compliance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SUPPLIERS

A. Disinfection of domestic water system:
   1. ARC Water Treatment Company, Inc.
   2. Ecolab
   3. Water Chemical Services, Inc.
   4. Olin Water Services

2.2 ABOVE GROUND PIPE

A. Copper: ASTM B 88, Type L hard drawn.

B. Ductile iron: AWWA C-151, Class 54, with AWWA C-104 cement lining.

2.3 ABOVE GROUND FITTINGS

A. Cast or wrought fittings for copper pipe:
   1. General: Solder joint, cast brass, ASME B16.18; or wrought copper, ASME B16.22.
   2. Flanges: Bronze, solder type, ASME B16.24, Class 150.

2.4 UNDERGROUND PIPE AND FITTINGS

A. Ductile iron pipe and fittings:
1. Pipe:
   a. AWWA C-151, Class 54.
   b. AWWA C-104 cement lining.
   c. AWWA C-111 mechanical or push-on joints.

2. Fittings: AWWA C-110, ductile iron, Class 350.

B. Copper Type K pipe and fittings:
   1. Pipe: Copper tubing, ASTM B 88, Type K, hard drawn, plain end.
   2. Fittings: Solder joint, cast brass, ASME B16.18, or wrought copper, ASME B16.22.

C. Abutments: Concrete, not less than three pipe diameters wide and two pipe diameters high.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install domestic water piping as shown on the drawings and in accordance with the provisions of Section 22 05 00, Common Work Results for Plumbing.

B. Install piping in accordance with the Schedule of Pipe Systems, Sizes, and Materials at the end of this section.

C. Provide drain valves at low points of domestic water system for drainage.

3.2 TESTING OF DOMESTIC WATER SYSTEM

A. When domestic water piping is completed, and before strainer baskets are installed, pressure test at the pressure shown in Piping Test Table in Section 22 05 00.

3.3 CLEANING OF DOMESTIC WATER SYSTEM

A. Flushing of new piping segments:
   1. Flush new domestic cold water, domestic hot water, recirculated hot water, and tempered water piping before using. Unless prescribed otherwise by the county or state health department, the method of flushing shall be as follows:
   2. Do not allow flushing water for piping to travel through plumbing equipment. Isolate equipment by closing isolation valves and opening bypass valves or by leaving piping disconnected from equipment.
   3. Flush new piping after new piping has been completed and prior to connection to existing building systems.
4. Flush new piping segments as the work progresses.
5. Provide temporary domestic water and drain piping as needed. Remove when flushing is complete.
6. Drain water from the segment low point to a safe location and replace water at the same rate.
7. Continue until drain water is free from sediment, scale, rust and other foreign substances.
8. Flush every new branch of piping, for a minimum of 15 minutes after running clean.
9. Install strainer baskets.
10. Disinfect piping segment as described below.

B. Flushing of building systems:

1. Flush domestic cold water, domestic hot water, recirculated hot water, and tempered water piping before using. Unless prescribed otherwise by the county or state health department, the method of flushing shall be as follows:
2. Do not allow flushing water for piping to travel through plumbing equipment. Isolate equipment by closing isolation valves and opening bypass valves or by leaving piping disconnected from equipment.
3. Flush new piping segments as the work progresses.
4. Provide temporary domestic water and drain piping as needed. Remove when flushing is complete.
5. Drain water from the segment low point to a safe location and replace water at the same rate.
6. Continue until drain water is free from sediment, scale, rust and other foreign substances.
7. Flush every new branch of piping, for a minimum of 15 minutes after running clean.
8. Install strainer baskets.
9. Disinfect piping as described below.

C. Disinfection of building systems:

1. Disinfect domestic cold water, domestic hot water, recirculated hot water, and tempered water piping before using. Unless prescribed otherwise by the county or state health department, the method of flushing shall be as follows:
2. Provide temporary domestic water and drain piping as needed. Remove when disinfection is complete.
3. Through a NPS 0.75 (DN 20) hose connection in the main downstream of the backflow preventer, pump in sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Provide plumbing connections and power for pumping chlorine into the system.
4. Fill all piping systems with chlorinated water.
5. Proceed downstream from the point of chlorine application, opening each water source for each faucet and outlet until chlorine is detected at a concentration of 200 ppm. Close each water source for each faucet and outlet when chlorine is evident at
6. Energize domestic water recirculation systems or provide another means of filling domestic hot water return piping with chlorinated water at a concentration of 200 ppm.
7. Retain this water in the system for at least three hours, but no more than 3.5 hours.
8. At the end of the retention period, verify that no less than 100 ppm of chlorine are present at the most remote end of the system.
9. Open all faucets and outlets and flush all piping until the chlorine residual in the water is less than 1 ppm.
10. Obtain a representative water sample from the system for analysis by a recognized bacteriological testing laboratory.
11. If the sample tested for coliform organisms is negative, the testing organization shall submit a letter and laboratory report to the Contractor, certifying successful completion of the disinfection. Submit the letter and report.
12. If any samples tested indicate the presence of coliform organisms, repeat the entire disinfection procedure.

3.4 SCHEDULE OF PIPE SYSTEMS, SIZES AND MATERIALS

A. Pipe schedules apply to domestic cold water, domestic hot water, domestic hot water return, and domestic temper water piping.

B. Above ground piping:

| NPS 2.5 (DN 65) and smaller | Copper Type L cast or wrought fittings | X |

C. Above ground water service entrance piping:

| NPS 2.5 (DN 65) and smaller | Copper Type L cast or wrought fittings | X |

D. Below ground piping:

| NPS 2.5 (DN 65) and smaller | Copper Type K cast or wrought fittings | Ductile iron push-on joints |

END OF SECTION
SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Backflow preventers.
B. Strainers.
C. Trap primers.
D. Water hammer arresters (shock absorbers).
E. Thermostatic water temperature controllers.
F. Water pressure reducing valves.
G. Pressure relief valves.
H. Solenoid valves.

1.2 RELATED SECTIONS

A. Piping: Section 22 11 16.
B. Flashings: Section 22 05 06.
C. Insulation: Section 22 07 19.

1.3 SUBMITTALS

A. Product data: Each specialty device or equipment, with installation instructions.
B. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

1.4 QUALITY ASSURANCE

A. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
B. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

C. Minimum working pressure for domestic water specialties: 125 psig (860 kPa) unless otherwise indicated.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Acceptable Manufacturers

1. Ames
2. Febco
3. Watts Industries
4. Zurn-Wilkins

B. Backflow preventer for domestic water service. ASSE 1013, reduced-pressure-principle type, dual check valves, relief valves assembly, tri-cocks, stop valves, ASME A112.1.2 air-gap fitting matching backflow-preventer connection.

2.2 STRainers

A. Acceptable Manufacturers

1. Keckley
2. Mueller Steam Specialty
3. Spirax Sarco Inc.
4. Tate Andale, Inc. “Guardian”
5. Watts Industries, Inc.

B. Minimum pressure rating: 125 psi (860 kPa)

C. Basket-type water strainers: Epoxy-coated cast iron, flanged, equal to Mueller Steam Specialty No. 165. Basket: Type 304 stainless-steel screen with 1/8-inch (3-mm) perforations.

D. Y-type strainers: Include with plugged blow-down connections and stainless steel strainers with maximum 0.045-inch (1.2-mm) perforations.

1. Pipe sizes NPS 2.0 (DN 50) and smaller: Equal to Watts Series LF777SI, brass body, threaded ends.
2. Pipe sizes NPS 2.5 (DN 65) and larger: Equal to Watts Series 77F-CSSI, stainless steel body, flanged ends.
2.3 TRAP PRIMERS

A. Trap primers from water closet flush valves:

1. Acceptable Manufacturers:
   
   a. Delaney
   b. Sloan
   c. Zurn Plumbing Products

2. Tailpiece assembly with chrome fittings and chrome-plated flexible copper tubing and wall flange. Provide product equal to Sloan Valve Company model VBF-72-A.

B. Pressure-differential type trap primers from domestic cold water pipes:

1. Acceptable Manufacturers:
   
   a. Precision Plumbing Products
   b. Sioux Chief Manufacturing
   c. Zurn Plumbing Products

2. ASSE 1018, equal to Precision Plumbing Products P-1 and P-2 Series trap primer valves. Primer valves shall accommodate one to four floor primer outlets. Primers shall release a metered amount of water when a 10 psi (69 kPa) pressure drop is sensed in the connected water line.
   
   a. Distribution unit: Connects directly to the primer valve with up to four 5/8 inch OD compression outlet fittings for NPS 0.5 (DN 15) copper tubing.
   b. 20 - 80 psi (138 - 552 kPa) operating range

C. Automatic trap priming system:

1. Acceptable Manufacturers:
   
   a. Hydronic Modules Corporation
   b. Precision Plumbing Products
   c. Sioux Chief Manufacturing
   d. Zurn Plumbing Products

2. ASSE 1044, equal to Precision Plumbing Products "Prime-Time Electronic Trap Priming System", factory assembled unit consisting of the following:
   
   a. Pre-set 24-hour timer that actuates a solenoid valve 10 seconds every 24 hours providing 2.0 ounces discharge at 20 psi inlet pressure.
b. NPS 0.75 (DN 20) copper inlet connection with bronze ball type shutoff valve.

c. NPS 0.75 (DN 20) supply manifold with ASSE 1001 atmospheric vacuum breaker, 5/8 inch compression outlet fittings for NPS 0.5 (DN 15) copper tubing. Provide one outlet for each floor drain to be primed. Manifold assembly shall be calibrated for equal water distribution.

d. Provide a steel surface-mounted cabinet with access cover where concealed above ceilings or mounted in mechanical rooms.

e. Provide a recessed cabinet with stainless steel access cover where mounted below ceilings in finished spaces. Access cover shall include full length piano hinge and key-lock handle.

f. Electrical: 120V/1/60 single-point power supply, circuit breaker, manual over ride switch and test button.

D. Trap primer piping:

1. Soft Copper Tube: ASTM B 88, Type L and Type K water tube with ASME B16.18 cast copper or ASME B16.22 wrought copper fittings, solder joints.

2.4 WATER HAMMER ARRESTORS

A. Acceptable Manufacturers:

1. MIFAB, Inc.
2. Josam Company
3. Jay R. Smith Manufacturing Company
4. Wade
5. Watts Drainage
6. Zurn Plumbing Products

B. ASSE 1010 or PDI-WH 201 certified:

1. Construction: Metal bellows or copper tube with piston.
2. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.5 THERMOSTATIC WATER TEMPERATURE CONTROLLERS

A. Acceptable manufacturers:

1. Powers Regulator Company
2. Lawler Manufacturing Company, Inc.
3. Leonard Valve Company
4. Symmons Industries, Inc.
B. General:

1. Provide units of sizes, capacities, and piping arrangements as indicated on the drawings.
2. Construction: Copper or bronze body with corrosion-resistant interior components.
4. Paraffin-based thermal actuation technology to sense and adjust outlet temperature with vandal-resistant locking mechanism to secure temperature setting.
5. 10 psi maximum water pressure drop at design flow rate.
6. Set units for the discharge temperatures specified below unless otherwise indicated on the drawings.

C. Master thermostatic water tempering valves:

1. ASSE 1017, equal to Powers Regulator Company "Hydroguard" LFMM430.
2. Union and check stop at each inlet.
3. Discharge temperature adjustment range: 90 degrees F - 160 degrees F. Set at 120 degrees F.
4. Rigid bulb indicating thermometer at supply outlet; 3-inch dial graduated 30 degrees to 130 degrees F, stainless-steel, hermetically-sealed with external calibration screw.
5. Minimum controllable flow rate without recirculation: 3.0 gpm.
6. Rough bronze finish.

D. Lavatory thermostatic tempering valves.

1. ASSE 1070, equal to Powers Regulator Company “Hydroguard” Series LFLM 495.
2. Integral checks and screen strainers at inlets and union end connections.
3. Discharge temperature adjustment range: 80 degrees F - 120 degrees F. Set at 110 degrees F.
5. Perform to a minimum flow of 0.5 gpm.

E. Water temperature and pressure control valve for darkroom: Equal to Powers Regulator packaged assemblies, “Fotopanel” Series 440-1000 with surface-mounted stainless-steel cabinet, including mixing valve with integral strainer, check and shutoff valves on supplies. Mixing valve discharge to have on-off valve, vacuum breaker, and dial thermometer. Operating handles for on-off valve, temperature adjustment, and cold water volume control shall protrude from front of cabinet. Unit capacities shall be as noted on drawings.
2.6 SOLENOID VALVES

A. Equal to ASCO 8210G227, 2-way, normally closed, PTFE seal, 120-V coil, stainless steel or brass body, threaded connections, 150 psi pressure rating for operation between 32 degrees F to 130 degrees F (0 degrees C to 54 degrees C), stainless steel spring, stainless steel core tube, stainless steel core, stainless steel plug nut, UL listed and Safe Drinking Water Act compliant.

2.7 PRESSURE RELIEF VALVES

A. ASME rated, NB approved, automatic reseating type conforming to ANSI Z21.22.

1. Provide straight pressure type where installed in pipeline and for protection of cold water vessels.
2. Provide combination pressure and temperature type where installed for hot water tanks and vessels.

2.8 WATER PRESSURE REDUCING VALVES

A. Acceptable manufacturers:

1. Watts Industries Inc.
2. Zurn-Wilkins

B. NPS 3 (DN 80) and smaller: Equal to Zurn-Wilkins Model 500XL, high flow capacity with direct acting integral bypass and balanced piston design. Construction: Low-lead cast bronze ASTM B 584 valve body, covers, stem, and plunger; Type 302 stainless-steel spring and stainless steel 300 series seat; FDA approved Buna Nitrile and EPDM elastomers. Ratings: 300 psi (2068 kPa) maximum working pressure; 140 degrees F (60 degrees C) maximum working temperature; 25 to 75 psi (172 to 517 kPa) reduced pressure range. Connections: ANSI B1.20.1 for threaded connections and ANSI B 16.22 for copper connections.

PART 3 - EXECUTION

3.1 INSTALLING BACKFLOW PREVENTERS

A. Install backflow preventers in the building water supply, 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.

B. Mount 48-inches (120 mm) above the floor unless otherwise noted on the drawings. Strainers may be deleted with backflow preventers at the water service entrance if a strainer is included at the water entrance valving assembly.
C. Install drains for backflow preventers with atmospheric-vent drain connections with air-gap fitting, and pipe as indicated on the drawings.

D. Do not install bypass piping around backflow preventers.

3.2 INSTALLING STRAINERS

A. Install Y-pattern strainers on the supply side of each control valve, water pressure reducing valve, solenoid valve, pump, and where indicated on the drawings.

B. Install a basket type strainer at the water service entrance.

3.3 INSTALLING TRAP PRIMERS

A. Provide flush valve type trap primers for floor drains in toilet rooms.
   
   1. Priming line shall be taken from the valve tailpiece of the nearest water closet to the floor drain to be primed.
   2. Provide one primer for each floor drain.

B. Provide pressure-differential type trap primers for floor drains outside of toilet rooms and where automatic trap priming systems are not indicated. Connect primers to cold water lines NPS 1.5 (DN 65) and smaller. Locate primer valves above the floor level of the drains they serve in janitor’s closets, storage rooms, or other spaces accessible to maintenance personnel. If these locations are not possible, mount in accessible locations concealed above ceilings.

C. Install automatic trap priming systems where indicated on the drawings.

D. Install a 0.5-inch (DN 15) shutoff valve in the branch line serving each primer valve or system.

E. Install primer assemblies level and plumb to ensure equal flow distribution to the primer lines.

F. Run primer outlet piping concealed with NPS 0.5 (DN 15) soft drawn copper pipes and pitch down toward drains at minimum 1.0 percent slope and connect to floor drain trap primer fittings. Replace kinked piping.
   
   1. Install Type L copper tubing except Type K copper tubing where installed below floor slabs on earth.
3.4 INSTALLING WATER HAMMER ARRESTORS

A. Size and locate water hammer arrestors as recommended by the Plumbing and Drainage Institute Standard PDI-WH 201 or ASSE 1010.

1. Install water hammer arrestors in each branch domestic water pipe (hot and cold) which feeds either a battery of fixtures or a single fixture.
2. Install water hammer arrestors upstream of quick-closure valves.
3. Install water hammer arrestor in accessible locations.

3.5 INSTALLING WATER TEMPERATURE CONTROLLERS

A. Install and connect controllers as shown on the drawings and in compliance with the manufacturer’s recommendations.

B. Adjust controllers to specified supply temperatures or as indicated on the drawings.

3.6 INSTALLING SOLENOID VALVES

A. Solenoid valves shall be line size.

B. Provide a shutoff valve and union upstream of the solenoid valve.

3.7 INSTALLING PRESSURE RELIEF VALVES

A. Install pressure relief valve in accordance with the equipment manufacturer's recommendations.

3.8 INSTALLING PRESSURE REDUCING VALVES

A. Install water pressure reducing valves with inlet shutoff valve and pressure gauges on inlet and outlet sides of valve.

B. Install bypass with shutoff valve around pressure reducing valve assembly.

END OF SECTION
SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. In-line circulator pumps.

1.2 RELATED SECTIONS

A. Motors: Section 22 05 13.

B. Controls: Sections 23 09 01 through 23 09 23.

1.3 SUBMITTALS

A. Product data: Include certified performance curves and rated capacities of selected models; shipping, installed, and operating weights; furnished specialties; and accessories for each type and size of pump specified. Indicate pumps' operating point on curves.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Shop drawings: Show layout and connections for pumps. Include setting drawings with templates, directions for installation of foundation and anchor bolts, and other anchorages.

1. Wiring diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance data: For each pump specified, to include in maintenance manuals specified in Division 01 and Section 22 01 01.

D. Certifications: Booster pump system: Written certification that each unit has been factory tested and performs as specified and scheduled.

1.4 REFERENCES

A. American Society of Mechanical Engineers/American National Standards Institute

1. ASME/ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

B. American National Standards Institute/ American Society of Heating, Refrigerating, and Air-Conditioning Engineers/ Illuminating Engineers Society

C. NSF International/American National Standards Institute
   1. NSF/ANSI 61 - Drinking Water System Components – Health Effects
   2. NSF/ANSI 372 - Drinking Water System Components, Lead Content

D. Underwriters Laboratories
   1. UL 508 - Standard for Industrial Control Equipment
   2. UL 778 - Standard for Motor-Operated Water Pumps

1.5 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 22 05 00, Common Work Results for Plumbing.

B. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61 and NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

C. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

D. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

E. Comply with the most recent version of ANSI/ASHRAE/IES Standard 90.

F. Department of Energy (DOE) compliance: Pump manufactures shall comply with US Department of Energy (DOE) energy conservation standard that pertains to applicable pumps with 1 horsepower or greater. These pumps shall be evaluated using the Pump Energy Index (PEI) that determines the efficiency rating and DOE compliance. The lower the number the higher the efficiency.
   1. Pumps shall have a PEI rating of 1 or less to comply with the standard.
   2. The PEI compliant rating shall appear on the pumps permanent nameplate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Specified units are the basis for design of the project. The following listed manufacturers also provide units of acceptable quality. If units by any of these manufacturers should be proposed, verify that they meet requirements specified in Division 01 and the article "Product Options" in Section 22 01 01, and submit shop drawings as specified in the “Submittals” article above.

B. In-line circulator pumps:

1. Armstrong Fluid Technology
2. Bell and Gossett, a xylem brand
3. Crane Pumps and Systems
4. Grundfos Pumps Corporation
5. Taco Comfort Solutions

2.2 PUMPS, GENERAL

A. Pumps shall comply with the DOE Energy Conservation Standard with a PEI rating of 1 or less.

2.3 IN-LINE CIRCULATOR PUMP

A. Equal to Taco Comfort Solutions Series 100S pumps of size scheduled on the drawings. Pump shall have stainless-steel body, with non-ferrous impeller, stainless-steel shaft, bronze sleeve bearing, two-piece carbon/ceramic seal assembly, one-piece spring coupling. Pump flanges shall conform to ASME/ANSI B16.1.

PART 3 - EXECUTION

3.1 INSTALLING IN-LINE CIRCULATOR PUMP

A. Provide in-line pumps with motor in correct position. Provide necessary bracket to building structure to support the pump independently from the piping.

B. Provide check valves in discharge lines with non-slam spring-loaded type.

C. Provide valves for isolating pump on both suction and discharge sides of each pump.

3.2 ADJUST AND CLEAN

A. Set pump controls for specified operation.

B. Before starting, perform preventive maintenance:

1. Lubricate bearings.
2. Disconnect couplings and inspect motors for proper direction of rotation.
3. Verify that each pump rotates freely by hand. If it is bound or drags, determine the cause and correct it.
4. Verify that pump controls are correct for the application.

3.3 STARTUP

A. Start motors.

B. Open discharge valves only.

C. Check general mechanical operations of systems and motors.

END OF SECTION
SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sanitary piping

B. Equipment drains

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 05 00

B. Sanitary waste piping specialties: Section 22 13 19

1.3 REFERENCES

A. Cast iron piping standards

4. CISPI 301: Standard Specification for hubless cast iron soil pipe and fittings for sanitary and storm drain, waste, and vent piping applications

B. Copper (DWV) piping standards

1. ANSI/ASME B16.29: Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fitting: DWV
2. ASME/ANSI B16.23: Cast Copper Alloy Solder Joint Drainage Fittings: DWV
3. ASTM B 306: Standard Specification for Copper Drainage Tube (DWV)

1.4 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.5 QUALITY ASSURANCE
A. Cast iron pipe and fittings shall be marked with the collective trademarks of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

B. Prior to any new piping installation, the Contractor shall verify the inverts of all piping to which new work is to be attached. The Contractor shall demonstrate to the satisfaction of the construction manager and/or Owner, that the connections to existing sanitary pipes meet the intent of the contract.

C. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

D. The Contractor shall rod, clean, and flush existing sanitary piping as necessary to maintain gravity flow.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Install each type of pipe and fittings in locations required or permitted in Part 3, including the Pipe Installation Schedule at the end of the section.

B. Cast-iron hub and spigot pipe and fittings:

1. Pipe: ASTM A 74 service class
2. Neoprene gaskets joints:
   a. Lifetime ASTM C 564 neoprene gasket joints

C. Cast-iron no-hub pipe and fittings:

2. Joints: Use one of the no-hub coupling options below
   a. Option 1 (for use in any location):
      (1) ASTM C 564 neoprene gaskets and two-piece cast-iron housing clamps and stainless-steel bolts and nuts.
      (2) Equal to products of MG Piping Products Company.
   b. Option 2 (for use in any location):
      (1) Corrugated 304 stainless-steel shields with four or six clamps and holding bolts conforming to ASTM C 1540 and rubber gasket sealing sleeves
conforming to ASTM C 564
(2) Equal to “Husky Series 4000” coupling or Mission "Heavy Weight Series CHW" coupling.

c. Option 3 (for use only where readily accessible, concealed from view, and in buildings that are 40 feet (12 meters) or less in height):

(1) ASTM C 564 neoprene gaskets and 24-gauge Type 304 stainless-steel housing, two stainless-steel bolted clamps.

3. Pipe and fitting restraints:

a. Provide for piping NPS 5 (DN 125) and larger
b. Factory fabricated pipe and fitting restraint assemblies rated to prevent pipe separation under fluid thrust forces up to 50 feet of head in conformance with CISPI 301.
c. Equal to Holdrite No. 117 No-Hub Pipe and Fitting Restraint.

D. Copper tube (DWV) pipe and fittings:

1. Pipe: copper tubing Type DWV, ASTM B 306

PART 3 - EXECUTION

3.1 PREPARATION

A. Connect piping as shown on the drawings. Check elevations of connection points before installing new work.

3.2 INSTALLATION, GENERAL

A. Use suitable tools and appliances for the safe and convenient handling and laying of pipe. Examine each section of pipe for defects. Do not lay any piece that is known to be defective. If any defective piece should be discovered after having been laid, remove and replace it at no change to the contract price.

B. Install piping in accordance with the Pipe Installation Schedule at the end of this section, as indicated on the drawings, and in accordance with Section 22 05 00, Common Work Results for Plumbing. Materials and work shall conform to local plumbing codes and health department regulations.

C. Thoroughly clean all pipe and fittings before installing them, and keep them clean until
the acceptance of the completed work. Cap or plug ends of lines to prevent debris from entering during construction.

D. Make changes in direction of sanitary piping with approved sanitary fittings, Y branches, 1/8 or 1/16 bends.

E. In soil, waste, and vent stacks where branches occur that are smaller than stacks, provide properly sized reducing fittings.

F. Install all sanitary piping at a 2 percent minimum downward slope in the direction of flow unless otherwise indicated.

G. Install vent piping at a 1 percent slope down toward vertical fixture vent or toward vent stack.

3.3 INSTALLING CAST-IRON PIPING

A. 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." Install restraint assemblies at pipe couplings and fittings for piping NPS 5 (DN 125) and larger.

3.4 INSTALLING COPPER PIPING

A. Install aboveground copper tubing according to Copper Development Association, Inc. (CDA) "Copper Tube Handbook."

3.5 SCHEDULES

A. Sanitary pipe installation schedule.

(See schedule, next page)
<table>
<thead>
<tr>
<th>Application</th>
<th>Cast-iron hub and spigot</th>
<th>Cast-iron no-hub</th>
<th>Copper tube (DWV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary, exterior or below slab on earth</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitary, concealed within walls, partitions, or ceiling space</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sanitary, interior exposed</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous drains from equipment</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Drains and cleanouts.
B. Flashing material.

1.2 RELATED SECTIONS

A. Piping: Section 22 13 16.
B. Flashings: Section 22 05 06.
C. Insulation: Section 22 07 19.

1.3 SUBMITTALS

A. Product data: Each specialty device or equipment, with installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General: Model numbers are provided in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by the acceptable manufacturers listed.

B. Drains and cleanouts:

1. Josam Company
2. Jay R. Smith Manufacturing Company
3. MIFAB, Inc.
4. Wade
5. Watts Drainage
6. Zurn Plumbing Products
2.2 FLOOR DRAINS AND FLOOR SINKS

A. Equal to the Zurn catalog numbers noted on drawings. Those installed in slabs on grade and above crawl space do not require flashing clamp devices. All others shall have flashing clamp devices.

B. Floor drain P traps shall have primer plugs.

C. Floor sinks shall have acid-resistant porcelain enamel interior finish with internal aluminum dome strainers.

2.3 FLEXIBLE FLASHING

A. Polyvinyl chloride sheet, flexible, waterproof, unreinforced, 40 mil minimum thickness, intended for use as a drain flashing.

2.4 CLEANOUTS

A. Cleanouts: Equal to following Zurn Catalog numbers. Those installed in slab on grade and in slab above crawl spaces do not require membrane flashing device. All others shall have flashing devices.

B. In sanitary lines:

1. Exposed piping: Z-1445 with bronze cleanout plug.
3. Concealed piping where more than 8 inches (205 mm) back from finished wall line: Install a sanitary 90 degrees long turn Y fitting with bronze cleanout plug extended out to finish 1 inch (25 mm) behind finished wall. Provide with Z-1460-9x9 cover plate (access panel) with vandalproof screws.

C. In underfloor sanitary lines: (See Floor Finish Schedule) All units complete with bronze plug.

1. In storage areas with plain or painted concrete floors: ZB-1400.
2. In exposed areas with plain or painted concrete floors: ZN-1400.
3. In resilient tile floors: ZN-1400-TX.
4. In ceramic tile floors: ZN-1400-T.
5. In carpeted floors: ZN-1400-CM.
6. In terrazzo floors: ZN-1400-DC.

D. Outside cleanouts shall be ZN-1400-HD with vandalproof screws.
PART 3 - EXECUTION

3.1 INSTALLING FLOOR DRAINS AND FLOOR SINKS

A. Where floor drains are over occupied areas, flash them with flashing specified in this section, single piece for each drain, 30 by 30 inches (762 by 762 mm) with opening cut in center to suit clamping device of drain. Adhere flashing to substrate with adhesive and secure to clamping device of drain. Ascertain that weep holes from drainage pan are open.

B. Generally, the rims of floor drains and sinks shall be set 1 inch (25 mm) below specified floor finish level and the floor sloped to the drain so as to finish flush with the rim.

C. Floor drains and floor sinks shall be provided with cast-iron P traps with primer connections, including those discharging directly into storm drains.

D. Floor drains and floor sinks shall be provided with trap primers.

   1. Refer to Section 22 11 19, Domestic Water Piping Specialties, for trap primers.

E. Floor drains shall be covered until placed in service to prevent the entrance of any foreign matter.

3.2 INSTALLING CLEANOUTS

A. Install cleanouts at base of each vertical, soil, waste, and vent stack, in the vertical piping.

B. Cleanouts shall be the same size as the pipe into which they are installed, except no cleanout shall be larger than NPS 4 (DN 100).

C. Install cleanouts in horizontal piping where indicated on drawings. Where cleanouts occur directly below a floor, the cleanout shall terminate with top flush with floor. Provide for the floor finish to be installed on the cleanout cover, and separated from surrounding material. Install carpet markers after carpet installation is completed. Install ceramic tile and terrazzo per manufacturer’s instructions.

D. Where cleanouts are over occupied areas, flash them with flashing specified in this section, by the same method specified for floor drains.

E. Cleanouts on exterior lines: Extend up flush with finish grade and support in a concrete pad, 18 by 18 inches (460 by 460 mm), 8 inches (205 mm) thick, reinforced with 6 by 6-inch (50 by 50-mm) No. 6 wire mesh.

END OF SECTION
SECTION 22 14 13 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air-conditioning condensate drain.
B. Storm water piping.
C. Foundation drain.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 05 00
B. Storm water piping specialties: Section 22 14 23

1.3 REFERENCES

A. Cast iron piping standards

4. CISPI 301: Standard Specification for hubless cast iron soil pipe and fittings for sanitary and storm drain, waste, and vent piping applications

B. Copper (DWV) piping standards

1. ANSI/ASME B16.29: Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fitting: DWV
2. ASME/ANSI B16.23: Cast Copper Alloy Solder Joint Drainage Fittings: DWV
3. ASTM B 306: Standard Specification for Copper Drainage Tube (DWV)

C. Copper Type L and M piping standards

1. ASME/ANSI B 16.18: Cast Copper Alloy Solder Joint Pressure Fittings
2. ASME/ANSI B 16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASTM B 88: Standard Specification for Seamless Copper Water Tube
D. PVC (DWV) piping standards

1. ASTM D 1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
2. ASTM D 2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

E. Perforated PVC piping standards

1. ASTM D 1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

F. Corrugated polyethylene piping standards


1.4 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.5 QUALITY ASSURANCE

A. Cast iron pipe and fittings shall be marked with the collective trademarks of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

B. Prior to any new piping installation, the Contractor shall verify the inverts of all piping to which new work is to be attached. The Contractor shall demonstrate to the satisfaction of the construction manager and/or Owner, that the connections to existing storm water pipes meet the intent of the contract.

C. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

D. The Contractor shall rod, clean, and flush existing storm water piping as necessary to maintain gravity flow.
PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Install each type of pipe and fittings in locations required or permitted in Part 3, including the Pipe Installation Schedule at the end of the section.

B. Cast-iron hub and spigot pipe and fittings:

1. Pipe: ASTM A 74 service class
2. Neoprene gaskets joints:
   a. Lifetime ASTM C 564 neoprene gasket joints

C. Cast-iron no-hub pipe and fittings:

2. Joints: Use one of the no-hub coupling options below
   a. Option 1 (for use in any location):
      (1) ASTM C 564 neoprene gaskets and two-piece cast-iron housing clamps and stainless-steel bolts and nuts.
      (2) Equal to products of MG Piping Products Company.
   b. Option 2 (for use in any location):
      (1) Corrugated 304 stainless-steel shields with four or six clamps and holding bolts conforming to ASTM C 1540 and rubber gasket sealing sleeves conforming to ASTM C 564
      (2) Equal to “Husky Series 4000” coupling or Mission "Heavy Weight Series CHW" coupling.
   c. Option 3 (for use only where readily accessible, concealed from view, and in buildings that are 40 feet (12 meters) or less in height):
      (1) ASTM C 564 neoprene gaskets and 24-gauge Type 304 stainless-steel housing, two stainless-steel bolted clamps.

3. Pipe and fitting restraints:
   a. Provide for piping NPS 5 (DN 125) and larger
b. Factory fabricated pipe and fitting restraint assemblies rated to prevent pipe separation under fluid thrust forces up to 50 feet of head in conformance with CISPI 301.
c. Equal to Holdrite No. 117 No-Hub Pipe and Fitting Restraint.

D. Copper tube (DWV) pipe and fittings:

1. Pipe: copper tubing Type DWV, ASTM B 306
2. Fittings:
   a. Wrought copper drainage fittings and soldered joints conforming to ASME/ANSI B16.29

E. Copper Type L and M pipe and fittings:

1. Pipe: ASTM B 88, Type L or M, hard drawn.
2. Fittings: Solder joint, cast brass, ASME B16.18; or wrought copper, ASME B16.22.

F. PVC (DWV) pipe and fittings:


G. Perforated PVC pipe and fittings:

   a. Perforations: Circular, not more than 0.3125 inch or less than 0.1375 inch in diameter, and arranged in rows parallel to the longitudinal axis of the pipe. Perforations approximately 3 inches, center-to-center, along rows. The rows approximately 1.5 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows spaced over not more not than 90 degrees of circumference. The coupling end of the pipe not perforated for a length equal to the depth of the socket and perforations continued at uniform spacing over the entire length of the pipe.
   b. Manufacturer’s standard perforated PVC pipe which essentially meets these requirements may be substituted when approved.
H. Perforated corrugated polyethylene:

1. Heavy-duty, highway-type conforming to AASSHTO M 252 and ASTM F 667, complete with snap couplings and fittings
2. Equal to product manufactured by Advanced Drainage Systems, Inc.

2.2 STORM WATER PIPING ACCESSORIES

A. Leader shoes: Cast-iron, conforming to downspouts shown on architectural and mechanical drawings, equal to Neenah Foundry Company Catalog No. R-4924 through R-4928.

B. Roof drain outlet: Equal to Zurn Z-199 downspout nozzle, flanged spout designed to direct roof overflow away from building.

1. Materials: Bronze, polished, with stainless-steel screen.
2. Size: Noted on drawings.

2.3 FOUNDATION DRAIN PIPING ACCESSORIES

A. Filter fabric:

1. Nonwoven polypropylene material recommended by the manufacturer for use in filtration or drainage
2. Equal to Carthage Mills FX-40NS, Amoco 4506, or Mirafi 160N.
3. Permittivity, ASTM D 4491: 90-115 gallons per minute per sq. ft. (6-7 L/s per 0.9 sq. m).
6. Trapezoid tear strength, ASTM D 4533: 45 lbs.

B. Pins for securing filter fabric: As recommended by the manufacturer, at least 15 inches (380 mm) long, 0.1875-inch (5-mm) diameter, with 1.5-inch-(38-mm) round washer attached to the top of the pin between staked ears.

C. Stone filter material: Uniform gradation, AASHTO M 43 size 67 or 7.

PART 3 - EXECUTION

3.1 PREPARATION

A. Connect piping as shown on the drawings. Check elevations of connection points before installing new work.
3.2 INSTALLATION, GENERAL

A. Use suitable tools and appliances for the safe and convenient handling and laying of pipe. Examine each section of pipe for defects. Do not lay any piece that is known to be defective. If any defective piece should be discovered after having been laid, remove and replace it at no change to the contract price.

B. Install piping in accordance with the Pipe Installation Schedule at the end of this section, as indicated on the drawings, and in accordance with Section 22 05 00, Common Work Results for Plumbing. Materials and work shall conform to local plumbing codes and health department regulations.

C. Thoroughly clean all pipe and fittings before installing them, and keep them clean until the acceptance of the completed work. Cap or plug ends of lines to prevent debris from entering during construction.

D. Make changes in direction of storm water piping with approved sanitary fittings, Y branches, 1/8 or 1/16 bends.

E. Install all storm water piping at a 2 percent minimum downward slope in the direction of flow unless otherwise indicated.

F. Seal air-conditioning condensate drain where it passes through outside wall and provide splash block if required.

3.3 INSTALLING CAST-IRON PIPING

A. 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." Install restraint assemblies at pipe couplings and fittings for piping NPS 5 (DN 125) and larger.

3.4 INSTALLING COPPER PIPING

A. Install aboveground copper tubing according to Copper Development Association, Inc. (CDA) "Copper Tube Handbook."

3.5 INSTALLING PVC (DWV) PIPING

A. Install aboveground PVC piping according to ASTM D 2665.

B. Install underground PVC piping according to ASTM D 2321.

C. Provide listed plastic pipe penetration protection at penetrations of fire-rated floors and assemblies.
D. PVC piping is not permitted in ceiling plenums or shafts used to convey HVAC system air.

3.6 INSTALLING STORM WATER PIPING

A. Install roof overflow piping extending 3.5 to 4 inches (75 to 100 mm) above roof. Flash as required for plumbing vents.

B. Install leader shoes complete with cleanout, as indicated on drawings.

C. Install roof overflow spout specified in Section 22 14 23 on each roof overflow drain outlet.
   1. Locations: Shown on drawings, no less than 12 inches (305 mm) above finished grade.
   2. Coordinate installation with wall construction and wall finish application materials.

3.7 INSTALLING FOUNDATION DRAINS

A. Excavation for pipe laid against footings shall not be lower than the bottom of the footing.

B. Installing stone filter material and geotextile filter fabric:
   1. Lay geotextile filter fabric, with material extending up as will be required to complete an envelope around stone filter material and piping.
   2. Install no less than 6 inches of stone filter material under pipe, and lay pipe.
   3. Fill with stone filter material no less than 6 inches (150 mm) on each side and 2 feet (610 mm) above piping, or to bottom of slab.
   4. Fold geotextile filter fabric over pipe and stone filter material to form a continuous envelope, overlapping no less than 2 inches. Top of geotextile envelope shall be directly under slab or between stone filter material and earth fill.

C. Where foundation drains pass through walls or footings, provide sleeves.

D. Lay drain lines at elevations noted on drawings, with uniform fall towards the points of discharge.

E. Lay pipe with perforations downward.

F. Verify joints are tight prior to backfilling. During backfilling assure that joints are not disturbed.
3.8 SCHEDULES

A. Storm water pipe installation schedule.

<table>
<thead>
<tr>
<th>STORM WATER PIPE INSTALLATION SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractor has option where more than one X appears on a line</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATERIAL TYPE</th>
<th>Cast iron hub &amp; spigot</th>
<th>Cast iron no-hub</th>
<th>Copper tube (DWV)</th>
<th>Copper Type L or M</th>
<th>PVC (DWV)</th>
<th>Perforated PVC</th>
<th>Perforated corrugated polyethylene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storm water, exterior or below slab on earth</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storm water, concealed within walls, partitions, or ceiling space</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storm water, interior exposed</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backflow preventer discharge drain piping</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air conditioning condensate, interior NPS 1 (DN 25) and smaller</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air conditioning condensate, interior NPS 1.25 (DN 32) and larger</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air conditioning condensate, exterior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Foundation drains, buried 10 feet (3 meters) deep or less</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation drains, buried 10 feet (3 meters) deep or more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Drains and cleanouts.
B. Flashing material.

1.2 RELATED SECTIONS

A. Piping: Section 22 14 13.
B. Flashings: Section 22 05 06.
C. Insulation: Section 22 07 19.

1.3 SUBMITTALS

A. Product data: Each specialty device or equipment, with installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General: Model numbers are provided in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by the acceptable manufacturers listed.

B. Drains and cleanouts:

1. Josam Company
2. Jay R. Smith Manufacturing Company
3. MIFAB, Inc.
4. Wade
5. Watts Drainage
6. Zurn Plumbing Products

2.2 ROOF DRAINS

A. Equal to Zurn ZA-100 R-C.
B. Include flashing clamp devices, roof sump receiver, and deck clamps. Where drains with extensions are required, the extension shall be suitable for the thickness of the insulation. Dome strainers: aluminum, removable, lockable in place and vandalproof.

C. Scupper drain: Equal to Zurn Z-187, size 8 by 12 inches (203 by 305 mm).

D. Lead for flashing roof drain: 4-lb (1.55-mm-thick) sheet.

2.3 ROOF OVERFLOW SPOUT

A. Equal to Zurn Z-199 downspout nozzle, flanged spout designed to direct roof overflow away from building.

B. Materials: Polished nickel bronze body with removable stainless-steel screen.

C. Size: Noted on drawings.

2.4 FLEXIBLE FLASHING

A. Polyvinyl chloride sheet, flexible, waterproof, unreinforced, 40 mil minimum thickness, intended for use as a drain flashing.

2.5 CLEANOUTS

A. Cleanouts: Equal to following Zurn Catalog numbers. Those installed in slab on grade and in slab above crawl spaces do not require membrane flashing device. All others shall have flashing devices.

B. In vertical storm lines:

1. Exposed piping: Z-1445 with bronze cleanout plug.
3. Concealed piping where more than 8 inches (205 mm) back from finished wall line: Install a sanitary 90 degrees long turn Y fitting with bronze cleanout plug extended out to finish 1 inch (25 mm) behind finished wall. Provide with Z-1460-9x9 cover plate (access panel) with vandalproof screws.

C. In underfloor storm lines: (See Floor Finish Schedule) All units complete with bronze plug.

1. In storage areas with plain or painted concrete floors: ZB-1400.
2. In exposed areas with plain or painted concrete floors: ZN-1400.
3. In resilient tile floors: ZN-1400-TX.
4. In ceramic tile floors: ZN-1400-T.
5. In carpeted floors: ZN-1400-CM.
6. In terrazzo floors: ZN-1400-DC.

D. Outside cleanouts shall be ZN-1400-HD with vandalproof screws.

PART 3 - EXECUTION

3.1 INSTALLING ROOF DRAINS

A. The first fitting below the roof drain shall be a T with cleanout plug, except over food preparation and serving areas.

B. Set roof drains to fit pitch of roof.

C. Sheet lead gaskets shall extend 12 inches (305 mm) beyond outer edge of roof drains and shall be secured with the flashing clamp.

D. Flashing clamp ring shall be embedded into the roofing and made watertight.

E. Ascertain that weep holes into drainage pans are open.

3.2 INSTALLING ROOF OVERFLOW SPOUT

A. Install spout on each roof overflow drain outlet. Outlets shall be at locations shown on drawings, no less than 12 inches (305 mm) above finished grade.

B. Coordinate installation with construction of wall and with application of wall finish materials, as applicable.

3.3 INSTALLING CLEANOUTS

A. Install cleanouts at base of each vertical storm water, soil, waste, and vent stack, in the vertical piping.

B. Cleanouts shall be the same size as the pipe into which they are installed, except no cleanout shall be larger than NPS 4 (DN 100).

C. Install cleanouts in horizontal piping where indicated on drawings. Where cleanouts occur directly below a floor, the cleanout shall terminate with top flush with floor. Provide for the floor finish to be installed on the cleanout cover, and separated from surrounding material. Install carpet markers after carpet installation is completed. Install ceramic tile and terrazzo per manufacturer’s instructions.

D. Where cleanouts are over occupied areas, flash them with flashing specified in this section.
E. Cleanouts on exterior lines: Extend up flush with finish grade and support in a concrete pad, 18 by 18 inches (460 by 460 mm), 8 inches (205 mm) thick, reinforced with 6 by 6-inch (50 by 50-mm) No. 6 wire mesh.

END OF SECTION
SECTION 22 34 00 - FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Gas-fired water heaters.

1.2 RELATED SECTIONS

A. Equipment Foundation: Section 22 05 29.


C. Expansion tanks: Section 22 05 09.

1.3 SUBMITTALS

A. Product data: Each type and size water heater. Include nominal capacity and pressure rating; shipping, installed, and operating weights; and specialties and accessories furnished for this project. Indicate dimensions, wall thicknesses, required clearances, method of assembly, and piping connections.

   1. Certification that fittings comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Include product data which verifies compliance with the energy performance requirements of ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.

C. Include operation and maintenance instructions and parts list for each type of water heater.

1.4 QUALITY ASSURANCE

A. Each water heater shall meet the energy performance requirements of ASHRAE 90.1.

B. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ANSI compliance: Provide gas water heaters that comply with ANSI standards for gas water heaters and related products and that bear AGA certification label.
D. ASME compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, “Pressure Vessels,” Division 01.

E. UL label and local testing (if required): As specified in Section 22 05 00, Common Work Results for Plumbing.

F. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

G. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

H. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

1.5 WARRANTY

A. In addition to the general project warranty, provide manufacturer’s standard limited warranty. Minimum 3-years on tank and heating surfaces covering waterside and condensate corrosion, leakage, production of rusty water, material defects and workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled products, or comparable product by of the following:

B. Gas-fired storage water heaters:

1. A.O. Smith Corporation
2. Rheem
3. Ruud
4. State Water Heater

2.2 COMMERCIAL, STORAGE, HIGH-EFFICIENCY CONDENSING GAS WATER HEATER

A. Provide unit of size and capacity shown on the drawings.
B. Unit construction:

1. Gas-fired water heaters will be of the BTU input(s) and storage capacity indicated on the drawings.
2. The water heater shall be vertical fire tube, constructed and stamped in accordance with Section IV, Part HLW of the ASME code. Water heater shall be National Board Registered for a working pressure of 150 psi and pressure tested at 1-1/2 times working pressure.
3. Gas-fired water heater shall be capable of utilizing liquefied petroleum gas (propane).
4. Gas-fired water heater shall have a minimum 95 percent thermal efficiency and meet the standing loss requirements of the U.S. Department of Energy (DOE).
5. Gas-fired water heater shall have a maximum hydrostatic working pressure of 160 psi.
6. Gas-fired water heater shall have a modulating gas burner that automatically adjust the input based on demand.
7. Gas-fired water heater storage tank shall be protected by power anodes that are non-sacrificial and maintenance free.
8. Water heater storage tank shall be welded steel, glass lining applied to all water-side surfaces after the tank has been assembled and welded.
9. Water heater storage tank shall have exterior foam insulation and factory painted metal jacketing.
10. Gas-fired water heater shall have a down-fired, direct spark ignition power burner designed for precise mixing of air and gas for optimum efficiency, requiring no field calibration upon startup.
11. Gas-fired water heater shall be approved for 0 inch clearance to combustibles.
12. Water heater control shall be an integrated solid state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout.
13. Water heater shall be certified by Underwriter’s Laboratory (UL) Inc., according to ANSI Z21.10.3 standards governing storage type water heaters.
14. Water heater shall comply with SCAQMD Rule 1146.2 and other air quality management districts with similar requirements for low NOx emissions.
15. Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems.
16. ASME-rated temperature/pressure relief valve set at 150 psi and 210 degrees F.
17. All water contacting tank surfaces will be non-porous and exhibit 0 percent water absorption.
18. All tank connections/fittings will be non-ferrous or stainless steel.
19. Combustion shall be provided by a premix, fan-assisted surface burner with a gas train meeting UL, ANSI and FM standards for the input specified.
20. Gas train components shall be capable of self-proportionating gas and air to maintain optimum combustion in response to varying vent pressures.
21. Water heater shall be a category IV, condensing appliance and vent through PVC or Polypropylene. Water heater shall satisfy requirements for sealed combustion.
22. Water heater shall be ETL listed for connection to a concentric vent termination.
23. Water heater shall be Energy Start listed and approved by U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE).
24. Water heater shall have submerged combustion chamber with helical heat exchanger coil positioned in center of tank surrounded by water to virtually eliminate heat loss from chamber.
25. Heat exchanger coil shall be glass-lined both externally and internally for optimum protection.

C. Insulation:

1. Fiberglass, limiting heat loss to no more than 14 BTU per hour per square foot of tank surface in ambient temperature of 65 degrees F.
2. Flame spread not to exceed 25 and fuel contribution not to exceed 50 when tested in accordance with ASTM E 84.

D. Exterior jacket: Polyethylene.

E. Concentric venting kit:

1. Water heater shall be furnished with the optional concentric venting kit by the water heater manufacturer.

F. Condensate neutralization kit:

1. Water heater shall be furnished with the optional condensate neutralization kit by the water heater manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide each heater with ASME rated temperature and pressure relief valves.

3.2 INSTALLING DOMESTIC WATER HEATER

A. Set heater on an equipment foundation (housekeeping pad). Plug all unused tappings.

B. Install level and plumb, according to drawings and referenced standards. Maintain manufacturer’s recommended clearances. Arrange units so that controls and devices are accessible.

C. Anchor water heaters to substrate.

D. Install and connect water heaters in accordance with applicable code for fuel-fired water heaters.
E. Install temperature and pressure relief valves. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.

F. Install water heater intake/exhaust venting and connect to water heater.

G. Install water heater condensate neutralization system and connect to water heater.

3.3 MANUFACTURER’S FIELD SERVICE

A. Provide manufacturer’s startup and adjustment for gas-fired water heater(s).

3.4 OPERATING INSTRUCTIONS

A. As specified in Section 22 05 00, provide operating instructions.

B. Provide at least 2 hours of additional instruction time for the equipment specified in this section.

END OF SECTION
SECTION 22 42 00 - INSTITUTIONAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Institutional grade plumbing fixtures and trim, faucets, other fittings, and related components.

1.2 RELATED SECTIONS


B. Valves: Section 22 05 23.

C. Plumbing specialties: Sections 22 11 19, 22 13 19, and 22 14 23.

1.3 SUBMITTALS

A. Product data: For each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Shop drawings:

1. Provide a schedule of fixtures and trim proposed for use, in the same order as the lists in the specification.

2. Wiring diagrams for field-installed wiring of electrically operated units.

1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 22 05 00, Common Work Results for Plumbing.

B. Fixtures shall be of the best commercial grade of their respective kinds, free from flaws, cracks, craze or other imperfections, complete with fittings and connections. Residential grade fixtures shall not be acceptable. Fixtures manufactured by acceptable manufacturers are acceptable provided they are equal and similar to those specified.

C. Fixtures and trim where required to be accessible to disabled people, identified in this section as “for disabled,” shall comply with requirements of the Americans with Disabilities Act (ADA) Regulations, as applicable to each type of fixture or its use.
1. Trim must meet requirements for force of operation at water pressures up to 80 psi.
2. Water closet models must be selected and installed so that flush controls will be on the fixture’s open side.

D. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

E. Acceptance product marking: NSF*-61 and NSF*-372 (or NSF*-61G) or other accepted certifier marks demonstrating third party certification with these requirements.

F. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following.

1. Fixtures:
   a. Acorn Engineering Co.
   b. American Standard
   c. Bradley Corporation
   d. Commercial Enameling Co.
   e. Crane Co.
   f. Eljer
   g. Elkay Manufacturing Co.
   h. Haws Corp.
   i. Just Co.
   j. Kohler Co.
   k. Zurn Plumbing Products

2. Emergency fixtures:
   a. Bradley Corporation
   b. Encon Safety Products
   c. Guardian Equipment
   d. Haws Corp.
   e. Speakman Co.
3. Faucets:
   a. Chicago Faucet Co.
   b. American Standard
   c. T & S Brass and Bronze Works, Inc.

4. Shower valves and accessories:
   a. Bradley Corp.
   b. Powers Process Controls
   c. Symmons
   d. Speakman Co.

5. Supplies, traps, and miscellaneous trim:
   a. Acorn Engineering Co.
   b. Bradley Corporation
   c. Brass-Craft Manufacturing Co.
   d. Chicago Faucet Co.
   e. Elkay Manufacturing Co.
   f. Engineered Brass Co.
   g. Guy Gray; IPS Corporation
   h. Haws Corp.
   i. McGuire Manufacturing Co.
   j. T & S Brass and Bronze Works, Inc.

6. Toilet seats:
   a. Bemis
   b. Beneke Corp.
   c. Church Seats
   d. Olsonite Co.
   e. Sperzel Co.

7. Flush valves:
   a. Delaney Flush Valves
   b. Sloan Valve Co.
   c. Zurn Plumbing Products

8. Water coolers and fountains:
   b. Elkay Manufacturing Company
c. Halsey Taylor
d. Haws Corp.
e. Oasis Water Coolers
f. Sunroc Corporation

9. Fixture supports and carriers:
   b. J.R. Smith
   c. Zurn Plumbing Products

2.2 FIXTURES

A. Model numbers are intended to describe complete fixtures. Furnish all parts and fittings regularly required such as tailpieces for lavatory faucets, escutcheons, and appurtenances, including low-voltage devices and wiring for fixtures which require them to operate.

B. Fixtures shall be white except where another color is specified for a particular fixture.

C. Water closet models specified or noted to be accessible in accordance with ADA requirements: Select models such that flush controls will be on the fixture’s open side when fixtures are installed.

2.3 WATER CLOSETS


2. Bowl type: Elongated, siphon jet, NPS 1.5 (DN 40) top spud.
3. Passageway: 2.125 inches (54 mm).
4. Mounting: Wall-mounted, 18 inches (458 mm) rim to floor. Include cast-iron carrier fitting to connect to support specified in the article “Supports for Wall-Mounted Fixtures” below.
5. Consumption: No more than 1.28 gallons (4.8 L) per flushing cycle.
6. Trim:
   a. Seat: No. 1
   b. Flush valve: No. 9.

2.4 LAVATORIES

A. F-2A lavatory for disabled: Kohler “Hudson” K-2868

1. Material: Cast iron with acid-resisting enamel.
2. Lavatory type: Rectangular, front overflow, 8-inch (203-mm) faucet centers.
3. Dimensions: 20 by 18 inches (508 by 457 mm).
4. Mounting: Wall-mounted, 34 inches (876 mm) rim to floor. Include cast-iron carrier fitting to connect to support specified in the article “Support for Wall-Mounted Fixtures” below.

5. Trim:
   a. Faucet: No. 50
   b. Tailpiece: Two No. 24
   c. Supply: Two No. 22
   d. Nipple: Two No. 62
   e. Drain: No. 80
   f. Trap: No. 106
   g. Lavatory insulation kit: No. 122

B. F- 2 lavatory for disabled: Elkay Model LRA.0252165PD

1. Material: 18 gauge 304 stainless steel.
2. Lavatory type: Single bowl drop-in type with perfect drain and 8-inch faucet centers.
3. Dimensions: 25 by 21.25 inches (635 by 540 mm) by 6.5 inches (165 mm).
4. Mounting: In countertop specified in Division 12.
5. Trim:
   a. Faucet: No. 50
   b. Tailpiece: No. 24
   c. Supply: Two No. 22
   d. Nipple: Two No. 62
   e. Trap: No. 106
   f. Lavatory insulation kit: No. 122

2.5 SERVICE SINKS

A. F- 3 sink, mop: Fiat Model MSB-2424.

1. Material: Molded stone, white with black accents.
2. Sink type: One-piece mop service basin with integrally molded shelf 10.5 inches (267 mm) wide.
3. Dimensions: 24 by 24 inches (610 by 610 mm), 10 inches (254 mm) deep. Both sides shall be 10 inches (254 mm) high with one-inch (25-mm) -wide shoulders.
5. Accessories: Drain body, No. 302 stainless steel, with combination dome strainer and lint basket, designed for an NPS 3 (DN 80) connection.
6. Trim:
   a. Faucet: No. 47.
   b. Mop hanger: No. 121.

2.6 OUTLET BOXES FOR WASHING MACHINE

A. F-9 Washing machine supply and drain box: Guy Gray Model SSWG 1.
   1. Material: 20-gauge, Type 304 stainless-steel box and cover.
   2. Mounting: Flush mount in partition 42 inches (1066 mm) above floor.
   3. Valves: NPS 0.5 (DN 15) hot and cold inlet valves. NPS 0.75 (DN 20) hose bibb outlet.
   4. Center drain: NPS 2 (DN 50) slipnut to be used with 2 inch pipe nipple or male adapter.
   5. Box dimensions: 8.25 by 6 inches (210 by 152 mm) by 3.5 inches (90 mm).
   6. Trim cover dimensions: 10.875 by 8.375 inches (276 by 212 mm).
   7. Trim:
      a. Vacuum breakers: Two No. 66

2.7 SINKS

A. F-4 sink, wash-up: Elkay Model LRADQ252165PD
   1. Material: Type 304 stainless steel, 18-gauge.
   2. Sink type: Single-bowl drop-in type with perfect drain and 8-inch centers.
   3. Dimensions: 25 by 21.25 inches (635 by 540mm) by 6.5 inches (165mm) deep.
   4. Mounting: In countertop specified in Division 12.
   5. Trim:
      a. Faucet: No. 48
      b. Tailpiece: No. 24
      c. Supply: Two No. 22
      d. Nipple: Tso No. 62
      e. Trap: No. 108

B. F-4A sink, scullery: Elkay Model RNSF8248LR2.
   1. Material: Type 304 stainless steel, 16-gauge.
   2. Sink type: Double-compartment with drain boards and seamless radius-coved corners, 8-inch (203-mm) faucet centers and 6.25-inch (159-mm) high backsplash, and 3.5-inch (89-mm) center drain.
   3. Overall Dimensions: 89 by 30 inches by 42 inches deep (2261 by 762 by 1067 mm).
4. Bowl Dimensions: 24 by 24 inches by 12.75 inches deep (610 by 610 by 324 mm).
5. Mounting: Floor-mounted, 16-gauge stainless 1.625-inch diameter tubular legs.
6. Trim:
   a. Faucet: No. 51
   b. Drain: No. 86

C. F-4B: Same as F-4 except include HAWS Model 7620 faucet mounted eye-wash.

2.8 WATER COOLERS

A. F-5 water cooler for disabled: Elray Model, barrier free, recessed mounted unit.
   1. Water cooler type: Refrigeration circuit with hermetically sealed compressor with air-cooled condenser.
   2. Capacity: To cool 8 gallons (30 L) per hour with inlet water 80 degrees F and room temperature 90 degrees F. Suitable for operation on 120-V, single-phase, 60-Hz current.
   3. Lead: Unit shall contain no lead. This requirement exceeds the standard designation of “lead free.”
   5. Bubbler: Chrome-plated brass with safety guard.
   6. Mounting: Bubbler shall be 36 inches (914 mm) above finished floor.
   7. Bottle filling station with brushed stainless-steel cabinet and hands-free activation.
   8. Fittings and accessories:
      b. Trap: Trim No. 106.

2.9 SHOWERS

A. F-6 built-in shower, adult, for disabled with conceal supplies: Bradley Type IC-HD-SB ADA compliant individual shower with fixed shower head and hand-held shower head.
   1. Enclosure and receptor: Not part of specified unit.
   2. Mounting height of shower head: 72-inch AFF.
   3. Fittings and accessories:
      b. Hand shower: Hand-held spray with 60-inch stainless-steel flexible hose and post-style mounting bracket to hold spray on panel. Elevated inline backflow preventer with quick disconnect for flexible hose. Model SB.
c. Accessories: Recessed cake soap tray, panel-mounted grab bar meeting accessibility requirements, folding shower seat with Naugahyde cover, shower curtain rod with vinyl curtain and hooks.

d. Flow control: HD pressure balance with single tempered/cold supply and lever handle.

2.10 HOSE REEL

A. F-2: Strahman Model M-200TS.

7. 0.5-inch flow unit: 5-7 gpm.
8. Single lever on/off operation.
9. Temperature control from 80 degrees F to 160 degrees F.
10. Provide chrome-plated unit.
11. Provide with hose assembly and M-70 series nozzle.
12. Liquid filled thermostat.

2.11 LIXIT

A. F-3: 0.5-inch Lixit nipple waterer with play guard L-80. Provide rough-in and complete connection.

2.12 TRIM

A. Exposed trim shall be chrome-plated.

B. Faucets: Equal to the named model shall mean similar in appearance, function, and design. Internal parts are not required to be interchangeable.

C. Flush valves shall be provided with vacuum breakers.

D. Trim numbers listed in the fixture descriptions above represent the descriptions in the article “Trim Schedule” at the end of the section.

2.13 SUPPORTS FOR WALL-MOUNTED FIXTURES

A. Lavatories mounted on shafts or partitions where there is no floor on the opposite side: Equal to Zurn Z-1259 plate carriers.

1. Single lavatory: The plate carrier shall have a backup plate of 10-gauge steel, at least 6 inches (152 mm) high by 38 inches (965 mm) long.
2. Battery-mounted lavatories: The 10-gauge backup plate shall be continuous for full length of battery of fixtures, with the carrier plates properly spaced and welded to the backup plate.
B. For lavatories mounted on partitions where there is a floor on the opposite side: Equal to Zurn Z-1224 plate carrier with legs anchored to floor.

C. Water closets: Carrier systems with special fittings, equal to Zurn Z-1203 or Z-1204 series as required for the various conditions.

D. Shower heads and shower valves on masonry walls: Anchor plates securely fastened to wall with a minimum of two stainless-steel or chrome-plated flat-head through bolts secured to back up plates set within wall. Back up plates shall be drilled for passage of pipes.

1. Single-mounted showerhead: The plate carrier shall have a back-up plate of 10-gauge steel, at least 6 inches (152 mm) high and 38 inches (965 mm) long.

E. Shower heads in stud walls: Shower valves and piping to be attached to nominal 2 by 6 inch (38 by 140 mm) fire-retardant-treated wood members with wood screws. Wood members shall be installed horizontally between studs and anchored in place with wood screws or lag bolts as required to provide a secure installation.

F. Other wall-supported fixtures: Cast-iron wall hangers securely bolted to wall.

1. Where void spaces occur on opposite side of partition: 0.375-inch through bolts with plate washers.
2. Where finished surfaces occur on opposite side of partition: Toggle bolts or bolts with plate washers built within the walls.

G. Wall-mounted water coolers: Equal to Zurn Z-1225 hangers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish, provide rough-in for, and set fixtures to extent and number indicated on drawings. The fixtures shall be left in first class condition, properly adjusted, cleaned and ready for satisfactory operation.

1. Where water closets are specified or noted to be accessible in accordance with ADA requirements, ensure that flush controls are installed on the fixture’s open side.
2. Coordinate elevations of water closet flush valve rough-ins with rough-ins for grab bars and other wall-mounted items.

B. Protect plumbing fixtures and board them over so that they cannot be used until final acceptance of the work.
3.2 Setting of Fixtures

A. In locations where fixtures are set against walls, seal crack between wall and fixture with silicon sealant.

B. Set floor outlet fixtures on floor flanges with gaskets and cement-grout them to rest firmly and evenly on floors.

C. Securely attach wall hung fixtures to wall using specified supports.

D. Install solids interceptor so that strainer can be removed for cleaning.

E. After installation, paint undersides of cast-iron lavatories and service sinks. Paint galvanized traps with two coats of white enamel.

F. Maximum length of risers shall be 8 inches.

3.3 Mop Sinks

A. Install basins for mop sinks as recommended by manufacturer with space between basin and wall completely filled with a waterproof silicon sealant. Provide P trap.

3.4 Installation of Outlet Boxes for Washing Machine

A. Install box(es) in accordance with the manufacturer’s recommendations.

3.5 Trim Schedule

<table>
<thead>
<tr>
<th>Trim No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Seat: Church No. 295 SSCT white solid plastic, elongated, open front; stainless-steel hinge posts with combination self-sustaining and check hinge.</td>
</tr>
<tr>
<td>9</td>
<td>Flush valve: Sloan “Royal” No. 111-1.28, complete with dual bypass filter diaphragm, vacuum breaker, NPS 1.5 (DN 40) top spud connection and flanges, 1.28 gallons (4.8 L) per flushing cycle. Include cast escutcheon, vandal-resistant stop cap, and ADA-compliant handle operation.</td>
</tr>
<tr>
<td>22</td>
<td>Rigid supply and stop: Chicago No. 1010-1003-3ABCP angle stop fitting with supply tube and loose key, with slow compression operating cartridge. Chrome-plated brass construction with 0.375-inch female threaded inlet and slip wall flange with set screw. Rigid supply riser with reducer for 0.25-inch female threaded outlet.</td>
</tr>
<tr>
<td>Trim No.</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>24</td>
<td>Tailpiece, straight: Brass Craft No. 56825X C complete with coupling nut.</td>
</tr>
<tr>
<td>47</td>
<td>Faucet: Chicago No. 445-897SRXKCCP, vacuum breaker spout with 3/4-inch male hose thread outlet, integral stops in shank, lever handles, adjustable support arms, wall brace with adjustable rod, and pail hook.</td>
</tr>
<tr>
<td>48</td>
<td>Faucet: Chicago No. 786-GR8AE35V7317AB deck-mounted manual faucet with 8-inch center, 8-inch restricted swing, gooseneck spout, 1.5 gpm softflow aerator, 4-inch vandalproof wristblade handles.</td>
</tr>
<tr>
<td>50</td>
<td>Faucet: Chicago No. 404-VE2805-317ABCP lavatory faucet with 8-inch fixed centers, vandalproof 4-inch wing handles, non-aerating laminar spray, 0.5 gpm.</td>
</tr>
<tr>
<td>51</td>
<td>Faucet: Chicago No. 510-GV8613L7XKCCAB, wall-mounted with adjustable arms for 8-inch centers, pre-rinse spray valve with 44-inch flexible stainless-steel hose, insulated handle, and inline backflow preventer, 12-inch L-type swing spout and vacuum breaker.</td>
</tr>
<tr>
<td>62</td>
<td>Nipples: Brass Craft triple-plated polished chrome of length and size as required.</td>
</tr>
<tr>
<td>66</td>
<td>Vacuum breaker: Watts No. 8AC to provide back-siphonage protection for portable hoses connected to hose thread faucets, non-removable. Tested and certified under ASSE 1011 and CSA B64.2. Inlet connection 0.75-inch standard female hose thread. Outlet connection NPS 3/4 (DN 20) standard male hose thread.</td>
</tr>
<tr>
<td>86</td>
<td>Drain: Elkay No. LK-35-B crumb cup strainer with 1.5-inch tailpiece.</td>
</tr>
<tr>
<td>106</td>
<td>P trap: McGuire No. 8090, 1.25 by 1.5 inch IPS outlet, cast-brass, ground joint, swivel type, with cleanout and complete with McGuire No. 2127, NPS 1-1/2 (DN 40) brass nipple with cast set screw escutcheon.</td>
</tr>
<tr>
<td>121</td>
<td>Mop hanger: Fiat Products, Inc. No. 889-CC 24 inches (610 mm) long by 3 inches (76 mm) wide, 18-gauge, No. 302 stainless-steel mop hanger complete with slotted matching screws for mounting.</td>
</tr>
</tbody>
</table>
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 22 70 00 – ANIMAL WATERER SYSTEMS

PART 1  GENERAL

1.1 SECTION INCLUDES

   A. Exterior Animal Waterer, installed in two outdoor yards adjacent to the main building.
   B. All plumbing and drainage connections.

1.2 WORK REQUIRED BUT SPECIFIED UNDER OTHER SECTIONS

   A. Division 23-Mechanical: Requirements for plumbing and piping systems.
   B. Division 26-Electrical: Requirements for electrical connections.

1.3 ACTION SUBMITTALS

   A. Product Data: For each type of product. Include data on all models specified, accessories, details of construction relative to materials, dimensions of individual components, profiles, and finishes.
   B. Shop Drawings: Show details of fabrication and installation. Include plans, elevations, sections, details and attachments to other work. Provide templates for anchors and bolts anchored to permanent construction.

PART 2  PRODUCTS

2.1 MANUFACTURERS ANIMAL WATERERS

   A. Manufacturers: Subject to compliance with requirements, provide products by on the following

      1. Nelson Manufacturing Company, Cedar Rapids, Iowa (888) 844-6606
         a) Series 700 Automatic Waterers – 730-10WS
         b) One drinker in each outdoor yard.

   B. Anchorage Devices: Provide anchor bolts, nuts, washers, bolts, sleeves, cast-in plate, and other anchorage devices as required to fasten housing assemblies securely in place and to suit installation type indicated. Hot-dip galvanize anchorage components.
C. Shut-off valves. One for each drinker located in the adjacent interior keeper work space.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Examine roughing-in for plumbing and piping systems to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Coordinate installation of waterers as indicated in drawings and instructions by manufacturer.

B. Provide rough-ins for water supply, drainage, and electrical conditions.

3.3 INSTALLATION

A. Attach waterers in a manner that complies with the requirements of the manufacturer.

3.4 TESTING AND ADJUSTMENTS

A. Test all equipment for proper and smooth operation. Adjust for proper operation. Correct all problems or inconsistencies.

END OF SECTION 22 70 00
SECTION 23 01 00 - OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Service for heating, ventilating, and air conditioning equipment required for the work as indicated on the drawings, including the items listed in “Related Sections”.

1.2 RELATED SECTIONS

A. Operating manuals: Division 01 and Section 23 01 01.

B. General project warranty: General Conditions.

C. Boilers: Section 23 52 16.

D. HVAC Fans: Section 23 34 00.

E. Unit heaters: Section 23 82 39.

F. Pumps: Section 23 21 23.

G. Air conditioning and heat pump units: Section 23 81 26 and 23 81 27.

H. Humidity control equipment: Section 23 84 13.

I. Air terminal units: Section 23 36 00.

1.3 DESIGN REQUIREMENTS

A. The products specified, scheduled, and shown on drawings are the basis of the design of this project.

B. For requirements affecting use of optional manufacturers, or substitutions, see Division 01 and Section 23 01 01, HVAC General Provisions, and Section 23 05 00, Common Work Results for HVAC.

1.4 SUBMITTALS

A. Shop drawings:

1. Refrigeration service organization: Name and address of proposed agency.

2. Burner startup and service organization: Name and address of proposed agency.
3. Proposed service or test agreement of each type included in the project, showing conformance to specifications. Include detailed list of work to be performed at each visit.

B. Certifications:

1. Qualifications of burner startup and service agency.
2. Qualifications of refrigeration installation and service agency.
3. Each installation and service organization: A list of at least ten projects, similar to this project in type, size, and components, which have been operating satisfactorily for at least two heating and cooling seasons.
4. Include evidence of each requirement specified in the article below for qualifications of each service and maintenance agency.

C. Field test reports:

1. Burner startup reports for each burner.
2. Test and inspection reports for refrigeration equipment.
3. Besides the number specified in general submittal requirements, submit copies to the Owner.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with the plumbing, electrical, building, fire and safety codes of the state, county or city in which the work is performed.

B. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

C. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1 Energy Efficient Design of New Buildings Except Low-rise Residential Buildings.

D. Burner operation shall meet the requirements for exhaust gases and temperature of the applicable authorities having jurisdiction.

1.6 QUALIFICATIONS OF EACH SERVICE AND MAINTENANCE AGENCY

A. Regularly engaged in performing installation, startup, and service work for equipment and systems of the types included in this project.

B. Staff factory-trained by the manufacturer of the equipment included in this project.

C. Provides emergency service on call 24 hours a day.
D. Maintains an adequate stock of manufacturer’s genuine or approved parts to service this equipment.

E. Has service contracts available, which can meet requirements specified for the equipment and systems of this project.

1.7 BURNER START-UP AND SERVICE

A. Provide startup and service for each burner installed as part of the work, by an agency qualified as described above.

B. Approved agency shall start, adjust, and test the complete burner system, and shall provide service as specified below during the term of the general project correction period.

C. Check all parts of the installation applicable to the burner, and verify that fuel piping installation, wiring, control installation, and appurtenances are in accordance with the recommendations of the burner manufacturer. Upon initial start-up, operate and adjust the burner to obtain the performance specified by the burner manufacturer.

D. Startup report shall include:

- Fuel pressure to nozzle - inches of Hg.
- Stack draft - inches wg, positive or negative
- Fire box pressure - inches wg, positive or negative
- Gross stack temperature - degrees F (maximum allowable 500 degrees F)
- Room temperature - degrees F
- Net stack temperature - degrees F
- CO₂ in fire box - percent CO₂
- CO₂ in flue gases - percent CO₂
- Smoke reading on the Bacharach scale
- Calculated combustion efficiency

1. Provide readings and calculations for both high and low fire settings, or six progressive sets of readings and calculations for modulating firing controls.

2. Test the operation of the flame safeguard control, all operating and limit controls, and the function of the low water cutoff. In the startup report, certify that these functions have been checked and that operation is satisfactory.

E. After the system has been operating under normal occupancy conditions for at least two weeks but not more than four weeks, repeat the adjustments and tests, and prepare another report including the same information.
F. During the first adjustment session, the Owner’s maintenance personnel shall be present, and shall be instructed in the proper operation of the burner and its associated control system.

G. Notify the Architect, Owner’s representative and representative of any authority having jurisdiction at least one week prior to the scheduled final start-up, so that they may arrange to have representatives present to observe the burner start-up and adjustment.

1.8 REFRIGERATION EQUIPMENT WARRANTY AND SERVICE

A. Manufacturer’s authorized and factory-trained startup and service organization will be responsible for starting, adjusting, and servicing the complete refrigeration system during the term of the correction period of this contract.

B. Ascertain that piping installation, wiring, control installation, and appurtenances of each refrigeration unit are in accordance with the recommendations of the manufacturer. Upon initial startup, operate and adjust the unit to obtain the performance specified by the manufacturer.

C. Special warranties shall cover the replacement of all parts and components for no less than the time of the general project correction period, starting from the date of substantial completion.

D. Compressors shall have an additional extended parts-only warranty for a total of five years including the general correction period.

E. Refrigerant circuits of self-contained units shall have an additional extended parts-only warranty for a total of five years including the general correction period.

F. Supply emergency service promptly upon call during correction period with no extra charge to Owner.

G. Maintenance in addition to repair: In addition to the repair service required during the correction period, provide maintenance by the manufacturer’s authorized factory-trained local agent including a visit to the project near the end of the first full cooling season. The planned maintenance program shall include:

1. Inspect complete refrigerant circuit for refrigerant leaks with approved halide or electronic leak detector.
2. Replace defective parts and refrigerant at no addition to the contract sum.
3. Tighten belts, nuts, screws, and terminal wiring connections as required.
4. Clean evaporator-condenser coils as needed.
5. Lubricate moving parts as needed.
6. Adjust, align, and replace belts where needed.
7. Check for oil or refrigerant leaks and correct as necessary.
8. Check for blockage of condensate elimination system and correct as required.
9. Check and record unit starting and running amperage.
10. Check and record power voltage and control voltage.
11. Check and record operating temperatures and pressure. (Pressure not required on hermetic circuits.)
12. Check and record thermostatic expansion valve super heat.
13. Check temperature and pressure controls and adjust as required.
14. Check for proper operation of limit switches and safety controls.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 ELECTRIC WIRING FOR MOTORS, STARTERS, AND CONTROLS

A. Furnish and install and in most cases factory-wire motor starters specified under each technical section in this division. Furnish and install under Division 26 starters not specifically specified with equipment. Unless specified otherwise, automatic control devices for equipment are furnished with the equipment.

B. Unless explicitly specified otherwise, mount and completely wire under Division 26 all starters and automatic control devices, except those which are factory-mounted on equipment.

C. Unless specified otherwise, motor disconnects, manual starters, pushbutton stations, and pilot lights are specified in Division 26, Electrical. Equipment specified in Division 23 shall be suitable for operation in conjunction therewith.

D. Unless specified otherwise in a particular section, electric motors shall comply with the requirements of Section 23 05 13.

3.2 IDENTIFICATION

A. Identify equipment as required in Section 23 05 00, Common Work Results for HVAC.

B. Thermometers, gauges, and control devices shall be identified.

3.3 TESTING MECHANICAL EQUIPMENT

A. Check and adjust all heating and cooling equipment installed.

B. Operate heating and cooling equipment and check controls including high and low limit controls.
C. Mechanical equipment shall be proven to function properly by actual operation prior to final acceptance.

3.4 EQUIPMENT LUBRICATION

A. Bearings of equipment shall be provided with adequate facilities for lubrication. Oiling devices shall be accessible. Lubricate bearings upon completion of work prior to startup of the equipment. Lubricants shall be as specified by equipment manufacturers.

END OF SECTION
SECTION 23 01 01 - HVAC GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for all HVAC work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Commissioning requirements: Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers


1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 23.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, including all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. HVAC work of this project includes, as a brief general description, the following:

1. Variable air volume, split air conditioning unit with terminal unit reheat.
2. Heating water system with condensing boiler and circulation pumps.

F. See Division 01 for requirements related to limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.
1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 23 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in the article “Substitutions,” below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

   1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
   2. Where specification permits “equal” products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 23 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacture. The description, characteristics, and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install.

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers’ instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.
G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent before starting any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate HVAC work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all piping, ductwork, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor’s responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors’ assistants shall include a competent foreman, who shall be on the premises at all times to check, lay out, coordinate and superintend the installation of work. The foreman shall establish all grades and lines relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers’ and subcontractors’ lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for
partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of shop drawings and product data for every item of equipment. Shop drawings or product data will not be considered until manufacturers’ lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.

2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor’s name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.

   a. For roof-mounted equipment, submit manufacturer’s certified drawings and other coordination drawings as required so that openings can be framed through the roof in accordance with structural requirements.

3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.

4. All exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identification specification paragraph.

5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.
1. Include project name, address, name and phone number of owner’s representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

1.10 SPECIALIST

A. The term “Specialist” as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer’s direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:
   b. Specifications.
   c. Addenda.
   d. Change orders and other modifications to the Contract.
   e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:
   a. Manufacturer’s name and product model and number.
   b. Product options, substitutions, or alternates utilized.
   c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:
a. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
b. Field changes of dimension and detail.
c. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.

2. Lubrication charts: Prepare lubrication charts for each piece of mechanical equipment that requires grease or oil.
   a. Include the following:
      1) Types of lubricants required.
      2) Locations of lubrication points.
      3) Frequency of lubrication.
   b. Provide one extra set of lubrication charts mounted in plastic covers, besides those required in Operating and Maintenance Manuals.

3. Binders: Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.

4. Prepare binder covers with printed title “OPERATION AND MAINTENANCE INSTRUCTIONS,” and title of project. Print on spine of binder “O & M INSTRUCTIONS.” If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.

5. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

6. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.

7. Part 1: Directory, listing names, addresses, and telephone numbers of mechanical engineers; Contractor; mechanical subcontractors; and major mechanical equipment suppliers.

8. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
   a. Significant design criteria, including pump and fan curves and similar performance charts.
b. List of equipment, including operating weight of each piece.
c. Parts list for each component, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
g. Valve charts, including locations of flow fittings.
h. New burner installations: Include firing rate, nozzle size, and fuel pressure.

9. Part 3: Project documents and certificates, including the following:
   a. Shop drawings and product data.
   b. Air and water balance reports.
   c. Photocopies of certificates.
   d. Photocopies of warranties and guarantees.
   e. Test reports: Copies of the results of all tests required under all sections of specifications.

10. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.

11. Submit final volumes revised, within ten days after final inspection.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The plumbing, mechanical, electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply. Products shall be certified by manufacturers to meet the requirements of referenced standards.

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Movement and Control Association (AMCA)
3. Associated Air Balance Council (AABC)
4. American Association State Highway and Transportation Officials (AASHTO)
5. American National Standards Institute (ANSI)
6. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
7. ASME International (ASME)
9. American Society of Sanitary Engineering (ASSE)
10. American Water Works Association (AWWA)
11. International Code Council (ICC)
12. Manufacturer’s Standardization Society of the Valve and Fittings Industry Inc. (MSS)
13. National Electrical Code, NFPA 70 (NEC)
14. National Electrical Manufacturer’s Association (NEMA)
15. National Fire Protection Association (NFPA)
17. National Sanitary Foundation (NSF)
19. The Occupational Safety and Health Act (OSHA)
20. Piping and Drainage Institute (PDI)
21. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
22. Underwriters Laboratory Inc. (UL)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.
1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Owner’s personnel or equipment.
6. Seal off all return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract Sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer’s recommended temperatures.

E. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in “Cutting and Patching” below.
B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.17 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Owner

C. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers’ standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.18 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor’s and subcontractors’ responsibilities are described in Division 01.
B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of pipes, ducts and appurtenances. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION
SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic material and equipment required for the piping work as indicated on the drawings and specified in Division 23.

B. Other requirements applicable to more than one section of Division 23.

C. Identification of HVAC systems and equipment.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 23 01 01.

B. Operation and Maintenance Manuals: Division 01 and Section 23 01 01.

C. Painting: Division 09.

D. Commissioning requirements: Division 01.

1.3 REFERENCES

A. American Society of Testing and Materials

1. ASTM A 234: Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

2. ASTM B 32: Standard Specification for Solder Metal

3. ASTM B 88: Standard Specification for Seamless Copper Water Tube

4. ASTM B 813: Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube

5. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position


1.4 DEFINITIONS
A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

C. DN: Dimension Nominale, nominal pipe size in millimeters, in accordance with the metric system for construction, Systeme Internationale (SI).

D. NPS: Nominal pipe size in inches, in accordance with standard U.S. designations for manufactured pipe. Pipe sizes do not change when projects are designed and built in metric units; each size has a consistent name (nominal dimension) in each system.

1.5 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed based on using the particular manufacturer’s products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:
   1. Product shall meet the specifications.
   2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that render their use impractical, or cause functional fit, access, or connection problems.

D. The contract drawings are generally diagrammatic and do not indicate all fittings or offsets in pipe, all access panels, or other specialties required.
   1. Install pipe exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining proper clearances for access at all parts requiring servicing.
2. Install pipe a sufficient distance from other work to permit a clearance of not less than 0.5 inch (15 mm) between its finished covering and adjacent work.
3. No pipe shall be run below the head of a window or door.
   a. Equipment, ducts, and pipes installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.
4. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.

1.6 SUBMITTALS

A. Shop drawings:
   1. Showing proposed expansion design.
   2. Schedule of welding and brazing procedures proposed for each piping system included in the project.

B. Certifications: Proof of operator and testing agency personnel qualifications as required for welding and brazing in the article "Quality Assurance" below.

C. Test reports: Field test results for each piping system as specified in Part 3 below.

1.7 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the plumbing, mechanical, electrical, building, fire, health and safety, and other applicable codes and regulations of the state, county or city in which the work is performed.

B. Welding procedures and operator qualifications for structural welding: AWS D1.1, Structural Welding Code Steel, electric arc process.

C. Welding, brazing, and soldering procedures and operator qualifications for building systems piping:
   1. AWS D10.9, Qualification of Welding Procedures and Welders for Piping and Tubing.
   2. ASME B31.9, Building Services Piping.
   3. Copper Development Association "Copper Tube Handbook."

D. Qualifications of independent testing laboratory personnel:
1. Welding inspectors: AWS QC1, Certification of Welding Inspectors.

E. Electrical control panels, equipment, materials and devices provided or installed as work of Division 23 shall bear UL label or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70 (NEC). Provide testing, if required, without addition to the contract sum.

1.8 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors’ and subcontractors’ responsibilities are described in Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General piping techniques, testing, identification, painting, and operating instructions specified in this section apply to products specified in other sections of Division 23.

B. Bituminous protective coating: Coal-tar based, self-priming on steel, applied in a wet film thickness at least 20 mils (0.5 mm) per coat; equal to 46H-413 "Hi-Build Tneme-Tar" manufactured by Tnemec Company, Inc.

C. Rust-inhibitive paint: Alkyd based, equal to Benjamin Moore Super Spec HP D.T.M. Alkyd Low Lustre P23; white, black, or bronzetone; applied in a wet film thickness of at least 2.9 mils (0.07 mm).

D. Weldolets and thredolets: Fittings designed for installing branches on piping, with either welded or threaded connection to branch; conforming to ASTM A 234.

E. Solder: Free of lead, antimony, and zinc and meeting the requirements of ASTM B 32. No solder containing lead is permitted.

1. Tin 95.5 percent, copper 4 percent, and silver 0.5 percent; equal to “Silvabrite 100” manufactured by Engelhard Corporation.
2. Tin, copper, bismuth, and silver; equal to "Oatey Silver" manufactured by Oatey.

F. Flux: Meeting the requirements of ASTM B 813 and NSF 61 certified, equal to Oatey H-2095.

G. Threaded pipe joint compound:
1. Pipe joint compound recommended by the manufacturer for use at the temperature and pressure of the system.

2. For gas service: As specified in Section 23 11 26, Liquefied-Petroleum Gas Piping.

H. Threaded pipe joint tape:

1. Polytetrafluoroethylene (PTFE) pipe thread tape, "Teflon."

I. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by ALSC Board of Review.

1. Application: Treat items indicated on the drawings, and the following:
   
   a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
   b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
   c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   d. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unreinforced below-grade areas.
   e. Wood floor plates that are installed over concrete slabs-on-grade.

2.2 MATERIALS FOR UNDERFLOOR INSTALLATION

A. Pipe: Copper tubing, ASTM B 88, Type L annealed temper (soft drawn), no joints under floor.

B. Conduit: Schedule 40 PVC pipe with long-radius elbows, size to accommodate copper tubing and insulation.

C. Insulation: Flexible elastomeric, as specified in Section 23 07 19, HVAC Piping Insulation.

D. Firestopping caulk: Equal to Three M CP 25 WB, intumescent caulk, which, under heat, expands to five times its original volume, creating a char which can withstand flames and smoke for at least three hours.

2.3 MATERIALS FOR BACKBOARDS FOR PIPING SPECIALTIES

A. Provide wall-mounted backboards for mounting piping specialties consisting of plywood board, supports, and fasteners.
1. Backboard: Moisture-resistant marine plywood, locations and sizes as indicated on the drawings.
2. Supports: Vertical backing rails, corrosion resistant, consisting of FRP composite structural shapes as indicated on the drawings.
3. Fasteners: Corrosion-resistant fasteners suitable for secure anchorage into wall construction behind backboards.

B. Marine plywood: BS-1080, Veneer Grade A/B, moisture-resistant marine plywood, spruce-pine-fir multiple ply, 5-ply minimum, pressure-treated construction, 0.563-inch (14-mm) thick minimum

C. Fiber reinforced plastic (FRP) composite structural shapes: ASTM D 635 and E 84, Pultruded FRP structural shapes, non-corrosive, flame retardant, thermosetting polyester resin, composite factory-fabricated shapes for assorted assemblies and field erection.

1. Ultimate tensile strength: 30,000 psi (207 MPa).
2. Modulus of elasticity: 2.8 x 10^6 psi (19,300 MPa).
3. Specific gravity: 1.6 to 1.75.
4. Density: 0.062 to 0.070 pounds/cubic inch (1.72 to 1.94 grams/cubic centimeter).
7. Shapes and sizes as indicated on the drawings
8. Submit shop drawings of assemblies.
9. Acceptable manufacturers:
   a. Bedford Reinforce Plastics Company
   b. Composites USA, Inc.
   c. Liberty Pultrusions, Inc.
   d. Strongwell Corporation
   e. Structural Fiberglass, Inc.
   f. Or approved equal.

2.4 IDENTIFICATION DEVICES AND MATERIALS

A. Stenciling materials:

1. Stencils: Manufactured standard stencils prepared for required applications, conforming to ANSI A13.1 for color and size of legend letters, including arrows showing direction of flow.
2. Paint: Exterior type enamel, colors conforming to ANSI A13.1, or black.

B. Equipment identification tags:

1. Laminated plastic with adhesive back, white core and black outer layers, which, when engraved, will produce white letters and numerals on a black background.
2. Tags installed on curved surfaces shall be aluminum or brass.

C. Valve tags: Brass, 1.5 inch (40 mm) in diameter with black-filled numbers not less than 0.25 inch (6 mm) high, complete with brass attachment chains.

D. Ceiling identification tags: Laminated plastic with adhesive back, engraved black letters on white background, minimum 0.5 inch (15 mm) wide and length as required for 0.375 inch (10 mm) high letters for name of concealed device and number.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

3.2 INSTALLING PIPING UNDER FLOOR SLAB

A. Install conduit.

B. Insulate copper tubing and insert in conduit.

C. Where piping rises through floor, cut conduit and insulation flush with floor.

D. Fill annular spaces with firestopping caulk. Use fiberglass insulation as backing.

3.3 PIPE INSTALLATION

A. Remove burrs resulting from cutting pipe or from any other operation.

B. Threaded connections:

1. Cut threads full and clean.
2. Apply specified pipe joint compound or tape on male threads only.
3. Where piping is installed in crawl spaces and tunnels, cover exposed threads with either bituminous protective coating or rust-inhibitive paint. Apply after joints have been assembled and tested.

C. Thoroughly clean pipe and fittings before they are installed, and keep them clean until the acceptance of the completed work. Cap or plug the ends of the lines so as to prevent earth and other debris from entering during construction.
D. Provide for expansion and contraction of piping and connections so that no strain or breakage will occur. Provide anchors and guides of approved design where shown on drawings and where necessary to allow for proper expansion and contraction. At the time of installation, expansion loops shall be cold sprung to one-half of the calculated expansion.

E. Provide for draining all parts of water piping systems and apparatus by installing a valved hose connection at every low point.

F. Black steel piping NPS 2.5 (DN 65) and larger shall be welded; NPS 2 (DN 50) and smaller shall be threaded, except as required otherwise in a particular section.

G. Do not weld galvanized piping.

H. Use welding fittings, tees, wyes, reducers, eccentric reducers, and caps as required. Branches at least two nominal pipe sizes less than the main may be made with "Weldolets" or "Thredolets" installed with full size opening in larger pipe and in accordance with manufacturer's printed instructions. Flanges shall be welded neck or slip-on pattern of class to suit the valves or equipment connections. Flanges shall have machine bolts with hex nuts and washers.

I. Each connection from risers to equipment shall contain at least three elbows or expansion joints. Connections shall be so arranged that movement in piping due to expansion and contraction will not be transmitted to the equipment.

J. Install unions and flanges in the piping at each item of equipment, control valve, and appliance, so as to provide easy removal of the equipment, valve, or appliance, and to provide for easy removal of coils.

K. Pitch water piping so that air in the system can be properly vented. Provide stop valves where necessary to isolate parts of system for repairs without draining the entire system.

L. Special techniques: Follow the techniques for soldering and brazing pipe, fittings, and valves as recommended by the manufacturer.

3.4 COPPER TUBING FOR WATER INSTALLATION

A. Solder joints for copper tubing: Clean ends of tubing and inside of fitting ends thoroughly with emery cloth before applying flux.

B. Provide dielectric fittings between copper and steel piping to prevent electrolysis.
C. Cut pipe with a tubing cutter or fine-tooth saw. Cuts made with a saw shall be true and square, and the end shall be filed smooth with a fine-tooth file. Remove all marks and burrs with sandpaper.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Where it is necessary to run pipes through walls, provide finished, permanent, waterproof installation complete with inserts, sleeves, supports or hangers, seals, and other appurtenances as required. Do not pierce, cut, or notch any footing or other structural member.

B. Waterproofing and dampproofing of the building shall be unharmed by the installation of the work. Where pipe has to pierce waterproofing or dampproofing, including outside walls, the penetration shall be made watertight. Waterproofing damaged or destroyed shall be repaired or replaced with new waterproofing.

3.6 IDENTIFICATION

A. General: Do not apply identification until insulation and finish painting work is complete.

B. Equipment:

1. Stencil equipment with minimum two-inch (50-mm) -high letters or provide identification tags. Clearly indicate equipment designation and area served.

2. Firmly fasten each identification tag to its appropriate piece of equipment with drive screws, sheet metal screws, or rivets. Do not interfere with operation of, or damage the item being marked.

C. Piping:

1. Mark by stenciling.

2. Mark to identify service with arrows showing direction of flow. Apply markings near building walls where pipes enter or leave an accessible space and in intermediate locations so that markings are no more than 30 feet (9 m) apart. They shall be readily visible to a person standing on the floor.

3. Fully identify all piping installed as work of the project.

4. Mark pipe with letters of height and with colors as required by OSHA and conforming to ANSI A13.1.

5. Identify every thermometer, gauge, and control device.

6. Provide valve tags for all valves except stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.
D. Stencil ductwork after insulation is applied, if required, with minimum two-inch (50-mm)-high letters, clearly identifying service (supply, return, exhaust) and showing direction of flow with arrows. Mark ducts near the building walls where they enter or leave a space, and at intervals of not more than 30 feet (9 m). Identification shall be visible to a person standing on the floor.

E. Ceiling identification tags: Provide on the access door or, in suspended ceilings, on the ceiling support adjacent to the unit.

   1. Valves: Identify with the same number shown on the valve tag.
   2. Terminal units above ceilings: Identify with unit description and number.

3.7 PIPING TESTS

A. Notify Owner at least 24 hours prior to the actual test in writing.

B. Test before pipes are concealed or insulated. Test the piping in sections as the work progresses, so as not to delay progress of the building construction. Furnish pumps and gages required for testing.

C. Conduct piping tests before connecting equipment that would be subject to damage from the test pressure. Replace piping or fittings found defective with new material.

D. Bracing and supporting: Adequately brace and support piping during the test, so that no movement, displacement, or damage results from the application of the test pressure.

E. Refrigerant piping: Test as specified in Section 23 23 00.

F. Test the piping systems for not less than four hours to fulfill the conditions in the Piping Systems Test Schedule at the end of this section.

G. Documentation of tests: Prepare a test report for each portion of piping tested, identified by service, material, location, and pipe size. Include these items:

   1. Date of test.
   2. Starting and completion times.
   3. Initial test pressure.
   4. Final test pressure.
   5. Problems or leaks detected.
   6. Corrective actions taken.
   7. Record of successful completion of testing.
   8. Name, title, and signature of person conducting test.
3.8 CLEANING AND PAINTING

A. Cleaning: Clean all piping and equipment. Where items are to be painted, clean ready for painting.

B. Painting: Coordinate painting with requirements of Division 09. Paint the items identified below to be painted. Use paint materials and systems specified in Division 09.

C. Items to be painted:

1. Items identified below to have protective coating.
2. Items furnished with manufacturer’s prime coat.
3. Mechanical rooms (including boiler, chiller, and air-handling unit rooms):
   a. Insulation and uninsulated steel: Piping, pumps, tanks, and vessels.
   b. Hangers and supports.

4. Piping and ductwork exposed in finished spaces, insulated and uninsulated.
5. Inside ducts behind registers, grilles, and diffusers.

D. Items not to be painted: Copper, stainless steel, and equipment furnished with manufacturer’s finish.

E. Paint systems in mechanical rooms: Paint piping using colors in accordance with ANSI A13.1.

   1. Galvanized steel: One coat of primer recommended for galvanized surfaces and one coat of glossy alkyd enamel.
   2. Ferrous metal: One coat of primer recommended for ferrous metal and one coat of glossy alkyd enamel.
   3. Items protected with bituminous coating or rust-inhibitive primer: Finish coat of compatible glossy enamel.

F. Paint systems for exposed piping and ductwork: Primer compatible with the substrate, whether steel, galvanized steel, insulation jacket, or other material; one coat or two, if required to cover, to match adjacent surfaces in color and texture.

G. Painting inside ducts behind registers, grilles, and diffusers: Matte black, compatible with substrate and suitable for the temperatures at which the duct will operate, extending from the duct opening to a depth such that no unpainted surface will be visible to a person standing on the floor or adjacent balconies.
3.9 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate all the HVAC systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of all systems and equipment.
   
   1. Instructions by manufacturer's technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Architect.

3.10 SCHEDULES

A. Piping Systems Test Schedule:

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEST PRESSURE PSIG (kPa)</th>
<th>ALLOWABLE DROP</th>
<th>MEDIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating water</td>
<td>125 (860)</td>
<td>None</td>
<td>Water</td>
</tr>
<tr>
<td>Fuel gas</td>
<td>100 (690)</td>
<td>None</td>
<td>*Air</td>
</tr>
</tbody>
</table>

* If pressure drops, locate leaks with soap and water solution

END OF SECTION
SECTION 23 05 01 - EXCAVATION AND FILL FOR HVAC WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for HVAC work underground inside the building and extending five feet beyond exterior building walls, and outside the building as shown on drawings.

B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 23 01 01.


1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft (2700 kN-m/cu m).

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities, and proposed detailed trenching plan.

B. Product data:

1. Warning tape
2. Seed and mulch

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.
B. Underground warning tape: Polyethylene 0.004 inch (0.102 mm) thick for metallic lines, and for non-metallic lines polyethylene both sides with metallic lining, six inches (152 mm) wide.

1. Colors: In accordance with APWA and AASHTO standards.
2. Markings: Repeated continuously along the entire length, legend appropriate for line being identified.

C. Grass seed: Fresh new-crop seed, 90 percent pure and 85 percent germination. Mix: 70 percent Kentucky Bluegrass, 25 percent Red Fescue and 5 percent Red Top. Only strains of Kentucky Bluegrass found adaptable to Maryland shall be acceptable.

D. Mulch: Free of sticks, weeds, or other foreign matter; either licorice root, tan root, or tan bark; fibrous by-product of extraction. Use only one type throughout the project.

2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local utility company underground information service (BGE Miss Utility) before beginning excavation outside buildings.

B. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.
D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the Architect.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where piping is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:

1. Water piping: 42 inches (1067 mm).
2. Fuel piping: 30 inches (762 mm).

C. Trenches shall be of necessary depth and width for the proper laying of pipe with a minimum of 8 inches (205 mm) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulations are stricter, trenches 4 ft. (1220 mm) and deeper shall have shored sides as required by OSHA trenching regulations.
2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except for bell holes and for the proper sealing of the pipe joints.
3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day's operation.
4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.

5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the Architect and do not place any portion of the work on such surfaces until instructions are received.

E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.

C. HVAC systems backfill:

1. Backfill and compact in six-inch (150-mm) layers up to spring line of the pipe. The installations shall then be inspected and tested.

2. Following inspection, backfill in six-inch (150-mm) layers, each compacted, until the pipe has a cover of not less than one foot (305 mm). Place the remainder of the backfill material in the trench in eight-inch (200-mm) compacted layers.

3. Excavations improperly backfilled shall be reopened, then refilled and compacted to the required grade and compaction, and smoothed off.

4. Open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that the entire depth of trench shall be backfilled in six-inch (150-mm) layers, and each layer shall be mechanically compacted.

5. Completed work shall have uniform graded surface, in accordance with the surface and grade indicated on the drawings.

D. Structure backfill:

1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.
3.6  COMPACTION

A. Test in accordance with the requirements of ASTM D 1557.

B. Compact under slabs, roads, and sidewalks to a 95 percent density.

C. Compact unpaved areas to a 90 percent density.

D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

E. Take particular care in compaction of earth under joints of HVAC piping.

3.7  SEEDING

A. Seed disturbed grass areas at the rate of 5 pounds (2.27 kg) per 1000 sq. ft. (92.9 sq. m), with the seed mix specified.

B. Uniformly distribute seed with an approved machine to ensure a covering of plus or minus 1/4 inch (6 mm). Sow half of the seed in one direction and the rest at right angles.

C. Do not seed during windy weather or when ground is wet or otherwise untillable. Seed between the dates of March 1st to May 1st or August 15 to October 15 unless otherwise approved in writing.

3.8  MULCHING

A. Mulch seeded areas immediately following seeding with fibrous mulch evenly applied at an average rate of 2 tons per acre (4483 kg per hectare) so as to provide a loose depth of not less than 2 inches (50 mm).

B. Wet down mulch, unless a heavy rain wets it, to the Architect's satisfaction, immediately after application.

3.9  RESURFACING

A. Resurface sidewalks, roads, streets, and other paved areas as work of this section, matching the construction and finish of adjacent paving.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sleeves and escutcheon plates for piping systems.
B. Mechanical seals for piping penetrations.

1.2 SUBMITTALS

A. Product data: Sleeves, plates, sealants, and mechanical penetration seals.

PART 2 - PRODUCTS

2.1 SLEEVES, PLATES, AND ACCESSORIES

A. Steel sleeves: Schedule 40 black steel pipe, ASTM A 53.
B. Copper sleeves: Type L, ASTM B 88 hard drawn.
C. Cast-iron sleeves: Extra heavy, equal to product of U.S. Pipe Co. with waterstop and ends as shown on the drawings.
E. Sealing compound in walls and floors: Equal to the following:
   1. Bare and insulated pipes carrying fluids 150 degrees F (65 degrees C) and below: Sika Corporation “Sikaflex - la.”
   2. Bare and insulated piping carrying fluids 151 degrees F (66 degrees C) and above: Dow Corning Corporation “790 Silicone.”
F. Floor, wall, and ceiling plates for existing piping: Stamped or cast brass with chrome finish and set screw, split and tabbed.
G. Floor, wall, and ceiling plates for new piping: Stamped or cast brass with chrome finish and set screw.
H. Mechanical penetration seals: Equal to PSI “Link-Seal Modular Seals” or Calpico Sealing Link “LINX”. Seals shall be modular mechanical type, consisting of interlocking synthetic links shaped to continuously fill the annular space between the pipe and wall.
opening. Bolt and nut fasteners for the seals shall be stainless steel for units used in penetrations below grade.

PART 3 - EXECUTION

3.1 INSTALLING SLEEVES

A. Install sleeves for piping, or piping with insulation continuous through sleeve, passing through walls, partitions, beams, or slabs.

1. Exception: Where steel pipe penetrates a steel beam that is not part of a fire- or smoke-rated assembly, no sleeve is required.

B. Do not cut, drill, or burn structural steel for installation of piping without specific instructions from the Architect.

C. Locations in nonfire-rated construction:

1. Install steel sleeves for penetrations of steel, iron, and insulated piping.
2. Install copper sleeves for penetrations of uninsulated copper tubing and piping.
3. Install plastic sleeves for penetrations of plastic piping. Plastic piping and sleeves are not permitted in ceiling spaces used as HVAC system plenums, or in shafts used for building HVAC air distribution.

D. Locations in floors and fire-rated construction: Sleeves used in piping penetrations through fire-rated construction shall be an acceptable component of the through-penetration firestop assembly as specified in Division 07.

1. Where firestop assembly is UL listed, sleeve material shall be as directed in the listing.
2. Where other specified approval and acceptance is required, sleeve shall be as described in the approved assembly.

E. Install sleeves through walls and partitions flush with finished surfaces.

F. Sleeves through floors shall extend 0.375 inch (10 mm) above top of finished floor and be finished neat and level. Sleeves through mechanical or equipment room floors shall extend one inch (25 mm) above finished floor. Provide projecting sleeves with anchor clips to prevent them from being loosened and knocked down in the floor construction.

G. Sleeves for insulated piping with vapor barrier shall be large enough to pass piping and insulation.

H. Seal spaces between sleeves and pipe, or pipe insulation, in nonrated walls, with mineral wool.
I. Penetrations in exterior masonry or concrete walls and foundations:

1. Sleeves: Cast iron, or in cast concrete may be core drilled.
2. Above grade: Mechanical penetration seal, at outside face of wall.
3. Below grade: Mechanical penetration seal, at outside face of wall.

3.2 INSTALLING PLATES

A. Exposed piping passing through interior walls, partitions, floors, and ceilings shall be fitted with plates of size and depth to conceal sleeves. Secure plates firmly in place with set screws.

END OF SECTION
SECTION 23 05 06 - CURBS AND FLASHINGS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Curbs, rails, and flashing devices for HVAC items and equipment penetrating roof and mounted on roof.

1.2 RELATED SECTIONS

A. Rough carpentry: Division 06.

B. Fans: Section 23 34 00.

C. Ductless split-system units: Section 23 81 27.

1.3 SUBMITTALS

A. Shop drawings: Roof curbs and rails, showing compatibility with roof membrane, insulation, and slope, and configuration for the supported equipment.

1.  If curbs are provided by curb manufacturer, coordinate with approved shop drawings provided as specified in related equipment sections, to determine configuration of equipment requiring curb support.

B. Product data: Each type of manufactured unit, accessory, and accessory material.

1.4 QUALITY ASSURANCE

A. Curbs and rails may be the product of the manufacturer of the equipment they support, or of a roof curb and support manufacturer, provided they are equal to the products of the named manufacturers and meet this specification.

1.5 SEQUENCING

A. Coordinate installation of rooftop equipment and supports with roof structure and membrane. Loads and penetrations shall not exceed or damage structural capacity or weathertightness.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Wood-preservative-treated lumber: As specified in Division 06 and in Section 23 05 00.

   1. Application: Treat items indicated on the drawings, and the following:

      a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.

2.2 PENETRATIONS OF SINGLE PIPE OR VENT

A. Basis-of-design product: Subject to compliance with requirements, provide the specified product, or comparable product by another manufacturer.

B. Boot for water piping through flat roof: Equal to Elmdor/Stoneman Engineering and Manufacturing Co. 1100-4, 4-lb (1.8 kg per 0.09 sq. m) lead boot, 8-inch (205-mm) skirt; top counterflashing fitting and waterproofing compound.

C. Vents through roof from steam or steam condensate return piping, and from steam condensate receivers: Stack flashing fitting designed for threaded connection to vent pipe and extension, with integral counterflashing, painted cast iron, equal to Josam 26440, or product of Zurn or Jay R. Smith.

2.3 PENETRATIONS OF GROUPS OF PIPES

A. Basis-of-design product: Subject to compliance with requirements, provide the specified product, or comparable product by another manufacturer.

B. Where a group of pipes penetrates the roof, provide a curb assembly equal to RPS Corporation Style RC. Assembly shall include curb, cover, and boots and clamps for the number of lines shown on the drawing. Curb shall be a minimum of 18-gauge galvanized steel, unitized construction with integral base plate insulated with 3-pound (48 kg/m²) density insulation, 2 by 2 inch (50 by 50 mm) nailer, acrylic-clad ABS plastic cover, and fastening screws. Boots shall be graduated step design EPDM rubber, with stainless-steel lock clamps.

2.4 CURBS AND RAILS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified product, or comparable product by one of the following:

1. Curbs Plus, Inc.
2. Pate Co.
4. ThyCurb Division, ThyBar Corp.
B. Fabricate each curb and rail in accordance with certified equipment drawings supplied by the equipment manufacturer, and with details on the drawings. Select style and configuration as required by roof membrane, insulation, and slope.

1. Height: At least 12 inches (305 mm) above top of insulation, except as otherwise shown on drawings.
   a. Fans ventilating kitchen hoods: At least 24 inches (610 mm), or more if required to place discharge of fan 40 inches (1016 mm) above roof surface.

2. Steel: 18 gauge, galvanized.
3. Construction: Monolithic, with all welded components, fully mitered corners, factory-attached wood nailer, and steel counterflashing.
4. Insulation: Fiberglass board, 3 lbs (48 kg/m³) density, 1.5 inches (38 mm) thick.
   a. Protective liner: On curbs serving duct systems made of aluminum, black steel, or stainless steel, or paint spray booth exhaust, provide liner of the same metal as the duct.

C. Curbs for condensing units 5 tons and smaller: Equal to Pate pedestal curb with solid top and “Dektite” flashing system, size to fit each unit.

1. Top: Provide plywood of adequate thickness, and with intermediate structural supports, as required to support the weight of the associated equipment without visible deflection of the solid top, and covered with no less than an 18 gauge galvanized steel counterflashing cap.
2. Pipe and conduit flashings: EPDM with ribbed aluminum base with mounting holes for screws, designed for field mounting on curb.
   a. Number: One for each pipe and conduit to the supported unit.
   b. Size: To suit pipe and conduit required for the unit.

2.5 ROOFTOP PIPE SUPPORT SYSTEM

A. Equal to Caddy “Pyramid ST” Series PSF UV-stabilized; polyethylene, polypropylene, and hot-dip galvanized strut-based support, 10 inches minimum strut length by 4 inches in height.

B. Provide manufacturer’s standard pipe clamps and accessories designed for strut system, as required for size, material, and configuration of air-conditioning condensate lines across roof.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Flashing of roofing felts into clamping devices of sleeves through roof, and flashing and counterflashing of pipe curb assemblies and of roof rails and curbs shall be as specified under Division 07, including all material and labor to waterproof roof.

B. Securely attach curb to roof construction with a 6-inch-(150-mm) wide wood frame, with countersunk flat-head 0.375-inch (10-mm) diameter cadmium-plated through bolts with washer and double nuts on underside of structural framing around roof opening. Secure curb to wood frame with No. 10 cadmium-plated wood screws.

1. Place bolts and screws on maximum 12-inch (305-mm) centers, with no fewer than two for each side of rail, curb, or frame.

C. Where dissimilar metals would come in contact with each other, coat them with bituminous protective coating or other coating compatible with adjacent materials.

3.2 INSTALLING ROOFTOP PIPE SUPPORT SYSTEM

A. Where air-conditioning condensate lines cross roof from equipment to drain, support on rooftop support system.

B. Use clamps and fasteners compatible with piping.

C. Follow manufacturer’s instructions.

END OF SECTION
SECTION 23 05 08 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specialties for piping systems.

1.2 RELATED SECTIONS

A. Hydronic piping: Section 23 21 13.

B. Expansion tanks and air separators: Section 23 05 09.

1.3 SUBMITTALS

A. Product data: For each specialty included in the work. Include rated capacities of selected equipment and manufacturer's installation instructions where applicable. Indicate materials, finishes, dimensions, required clearances, methods of assembly of components; and piping and wiring connections.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Flexible connections:

1. Flex-hose Company
2. Keflex (Flex-Weld Inc.)
3. Mason Industries, Inc.
4. Metraflex

B. Y-type strainers:

1. Keckley
2. Mueller Steam Specialty
3. Spirax Sarco Inc.
4. Tate Andale, Inc. “Guardian”
5. Watts Industries, Inc.

C. High-capacity automatic air vents:

1. Amtrol Inc.
2. Hoffman Specialty Div. of ITT Industries
3. Spirax Sarco Inc.
4. Spriotherm, Inc.
5. Taco, Inc.

D. Automatic air vents:

1. Hoffman Specialty Div. of ITT Industries
2. ITT Bell and Gossett
3. Spirax Sarco Inc.
4. Spriotherm, Inc.
5. Taco Inc.

E. Manual air vents:

1. ITT Bell and Gossett
2. Taco, Inc.

F. Water pressure reducing valves:

2. Watts Industries Inc.

G. Chemical feeder:

1. Neptune Chemical Pump Company
2. Vulcan Laboratories Inc.

2.2 FLEXIBLE CONNECTIONS

A. Flexible connections NPS 2 (DN 50) and smaller:

1. Copper pipe:
   a. Body: Corrugated bronze bellows waterway with woven flexible bronze outer shield.
   b. Connections: Female sweat.
   c. Performance: Capable of 0.5-inch (13-mm) minimum permanent offset.
   d. Pressure rating: 150 psig (1035 kPa).
   e. Maximum Operating Temperature: 250 degrees F (121 degrees C).
   f. Equal to Metraflex Company model BBS.

2. Steel pipe:
b. Connections: Female threaded.
c. Performance: Capable of 0.5-inch (13-mm) minimum permanent offset.
d. Pressure rating: 150 psig (1035 kPa).
e. Maximum Operating Temperature: 250 degrees F (121 degrees C).
f. Equal to Metraflex Company model SST.

2.3 WATER SPECIALTIES

A. Y-type strainers:

1. Steel pipe, threaded:
   b. Screen: Type 304 stainless steel with 0.045-inch (1.2-mm) maximum perforations.
   c. Pressure rating: 250 psi (1720 kPa) saturated steam, 300 psi minimum (2070 kPa) cold working pressure.
   d. Equal to Spirax Sarco IT.

2. Steel pipe, flanged:
   b. Gasket: Graphite.
   c. Screen: Type 304 stainless steel with 0.045-inch (1.2-mm) maximum perforations.
   d. Pressure rating: 125 psi (862 kPa) saturated steam, 200 psi (1380 kPa) cold working pressure.
   e. Equal to Spirax Sarco CI.

3. Copper pipe:
   b. Connections: Threaded.
   c. Gasket: Graphite for sizes above NPT 2 (DN 50).
   d. Screen: Type 304 stainless steel with 0.045-inch (1.2-mm) maximum perforations.
   e. Pressure rating: 250 psi (1720 kPa) saturated steam, 400 psi (2760 kPa) cold working pressure.
   f. Equal to Spirax Sarco BT.

B. Air vents:

1. High-capacity automatic air vent: Float operated air vent for releasing air from air separators in hydronic systems.
a. Body and cover: Cast iron or bronze.
b. Float, seat, and pin: Stainless-steel or bronze.
c. Inlet and drain connections: Threaded.
d. Operating pressure: 150 psig (1030 kPa) minimum.
e. Operating temperature: 250 degrees F (121 degrees C) minimum.
f. Capacity: 7 cfm (3.3 L/s) minimum.

   a. Body: Cast brass.
   b. Internal Parts: Nonferrous metal.
   c. Inlet and drain connections: Threaded.
   d. Operating pressure: 150 psig (1030 kPa) minimum.
   e. Operating temperature: 250 degrees F (121 degrees C) minimum.

3. Manual air vent:
   a. Body: Bronze or brass.
   b. Internal Parts: Nonferrous metal.
   c. Operator: Screwdriver or thumbscrew.
   d. Inlet and drain connections: Threaded.
   e. Pressure rating: 150 psig (1030 kPa) minimum.
   f. Maximum Operating Temperature: 225 degrees F (107 degrees C) minimum.

C. Pressure relief valves: ASME rated, NB approved, automatic reseating type conforming to ANSI Z21.22.
   1. Provide straight pressure type for pipe lines and for protection of coils and cold water vessels.
   2. Provide combination pressure and temperature type for hot water tanks and vessels.

D. Water pressure-reducing valves:
   1. NPS 2 (DN 50) and smaller:
      a. High-capacity, directly operated, designed for variable flow rate while maintaining close regulation of the reduced pressure.
      b. Construction: Single-seated, opening in the direction of flow, with a soft disc; cast bronze with threaded ends suitable for maximum inlet conditions of 300 psi (2070 kPa) at 160 degrees F (71 degrees C).
      c. Provide proper spring for range indicated on the drawings.
      d. Valve shall meet ASSE Standard 1003 and MIL-V-18146.
      e. Equal to Spence Model D-36,
2.4 CHEMICAL FEEDER

A. Five gallon capacity, cast-iron or welded-steel body, rated for pressure of 200 psi, complete with capped filling opening, connections, inlet, outlet and drain valves, and accessories, as detailed on the drawings.

PART 3 - EXECUTION

3.1 INSTALLING FLEXIBLE CONNECTIONS

A. Provide flexible connections to base-mounted pumps, and to air-handling units where indicated. Flexible connections may also be used in connections to other equipment to provide proper alignment of piping with equipment connections. Piping on house side of flexible connections shall be securely anchored.

3.2 INSTALLING WATER SPECIALTIES

A. The pressure-reducing valves and pressure-relief valves adjusted to the pressures indicated on the drawings.

B. Y-type strainers: Provide Y-type strainers where indicated on piping diagrams to protect valves and coils from debris. Provide shut-off valve in blow down connection with cap within mechanical rooms.

C. Air vents:

1. High-capacity automatic air vents: Provide high-capacity automatic air vents at air separators and other locations where noted. Provide copper tubing, full size of the high-capacity automatic air vent discharge connection, from each high-capacity automatic vent to nearest floor drain. Provide shut off valves in inlet piping to high-capacity automatic air vents.

2. Automatic air vents: Provide automatic air vents where indicated on piping diagrams and at high points of piping within mechanical rooms. Provide copper tubing, full size of the automatic air vent discharge connection, from each automatic vent to nearest floor drain. Provide shut off valves in inlet piping to automatic air vents.

3. Manual air vents: Provide manual air vents where indicated on piping diagrams, at each high point in piping outside of mechanical rooms, and at each terminal equipment hydronic coil.

D. Pressure relief valves: Provide pressure relief valves for devices where required by governing codes. Pipe pressure relief valve discharge to the nearest floor drain or to within six inches of the floor beside unit as indicated. Provide line size pressure relief valves unless otherwise noted.
E. Water pressure-reducing valves: Provide and adjust pressure-reducing valves at makeup water connections to regulate system fill pressure. Provide line size water pressure-reducing valves unless otherwise noted.

3.3 INSTALLING CHEMICAL FEEDER

A. Install on steel angle supports, complete with connections and accessories. Assure that the cap is in place and operable. Provide piping full size of chemical feeder connections between pumped discharge and pump suction as diagrammed on plans. Provide shut-off valves to isolate chemical feeder.

END OF SECTION
SECTION 23 05 09 - HVAC EXPANSION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precharged bladder-type expansion tank and coalescing air and dirt separator with vent.

1.2 RELATED SECTIONS

A. Piping: Section 23 21 13.

B. Supports: Section 23 05 29.

1.3 SUBMITTALS

A. Product data: Each type of expansion system or tank, including each relief and air separation device and all accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified and scheduled products, or comparable products by one of the following:

1. Expansion tanks:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell and Gossett Domestic Pump Div of ITT
   d. Taco
   e. Wessels

2. Coalescing air and dirt separators:
   a. Spirotherm
   b. Wessels
   c. Taco

2.2 BLADDER-TYPE EXPANSION TANK
A. Pressurized bladder-type tank, Taco CA or CBX model number scheduled on the drawings, containing impermeable bladder which separates the air cushion from the system water. Operating temperature: 240 degrees F maximum. Precharge to system fill pressure.

B. Shell: Welded steel, constructed, tested and stamped in accordance with ASME BPV for Unfired Pressure Vessels for a working pressure of 125 psi (860 kPa), lined with protective coating.

C. Bladder: Butyl rubber, flexible but not stretchable under working conditions, removable for inspection.

D. Size and capacity: Shown on the drawings.

E. Supports: For horizontal or vertical support on concrete equipment foundation, as diagramed on the drawings.

2.3 COALESCING AIR AND DIRT SEPARATOR

A. Air and dirt separator: Taco 4900 series as scheduled, coalescing type, designed to eliminate free and entrained air and dirt from the system.

B. Construction: Welded black steel, ASME constructed and labeled for 125 psig (860 kPa) working pressure.

1. Connections:
   a. NPS 2 (DN 50) and smaller: Threaded.
   b. NPS 2.5 (DN 65) and larger: Flanged.

2. Air-removing element: Copper or stainless-steel coalescing medium.

3. Factory-installed blowdown valve for removal of dirt from the bottom of the tank.

4. Factory-installed manual air vent for elimination of large quantities of air during initial system fill.

5. Factory-installed automatic air vent for elimination of captured air during normal system operation.

C. Size: Selected so that, at the maximum flow rate of the system, separator inlet velocity is such that the maximum volume of entrained air will be eliminated.

2.4 AUTOMATIC AIR VENT

A. As specified in Section 23 05 08, HVAC Piping Specialties. Float type vent, size and capacity recommended by manufacturer for tank and system.
PART 3 - EXECUTION

3.1 INSTALLING EXPANSION TANKS

A. Follow manufacturer’s instructions and recommendations.

B. Install piping, air separation apparatus, and vents as diagramed on drawings.

C. Install supports as shown on drawings.

3.2 INSTALLING AIR AND DIRT SEPARATOR

A. Suspend from overhead hanger.

B. Provide transition fittings if required to match size of pipe and size of air separator connection.

C. Provide automatic air vent and install drain pipes between vent and floor drain.

D. Install drain pipes from blowdown valve to a point near the floor convenient for removal of discharge with a bucket.

E. Make automatic fill connection from cold water main to system, as shown on diagrams.

3.3 CLEANING

A. Remove and clean air separator air-removing element after 24 hours operation, and after 30 days operation.

3.4 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Unless otherwise specified in a particular section or required for a particular application, motors shall conform to the following requirements, whether factory-installed or field-installed.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Motor capacitors: Section 26 05 21, Wiring Connections.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Pumps: Section 23 21 23.

B. Air-conditioning and heat pump units: Sections 23 81 26 and 23 81 27.

C. Fans: Section 23 34 00.

D. Unit heaters: 23 82 39.

E. Variable frequency drives: Section 26 29 23.

1.4 REFERENCES

A. NEMA MG 1: Motors and Generators.


D. UL 508: Industrial Control Equipment.

1.5 DEFINITIONS

A. Energy efficient motor: Motor meeting the nominal and minimum efficiency levels listed for its horsepower and speed in Table 12-10 of NEMA MG 1.

B. Nominal efficiency: Efficiency as defined in Table 12-8, Efficiency Levels, in NEMA MG 1, and identified on the motor nameplate.
1.6 SUBMITTALS

A. Product data:
   1. Motors and drives not provided with equipment: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lugs, and coatings.

B. Wiring diagrams required for the proper installation of mechanical equipment.

C. Submit product data which verifies compliance with ASHRAE 90.1 or provide certified performance ratings by a qualified independent testing agency.

D. Certifications:
   1. Actual motor power factor for each motor, certified test results for each motor proposed for use on this project.
   2. Field test showing corrected power factor, if required.
   3. Motors controlled by variable frequency controllers: Certification that motor meets specified requirements.

1.7 QUALITY ASSURANCE

A. Actual motor power factor shall be tested and certified by an independent testing laboratory.

B. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

C. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

1.8 REGULATORY REQUIREMENTS

A. Motors shall conform to the requirements of NEMA MG1 and applicable portions of the National Electric Code (NEC, NFPA 70).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Motors:
   1. Baldor Electric Co.
2. Marathon
3. Rockwell
4. Siemens
5. A.O. Smith
6. Toshiba International

B. Motor capacitors:

1. ABB Power Distribution
2. Commonwealth Sprague
3. General Electric

2.2 BASIC MOTOR REQUIREMENTS

A. Capacity: Each motor shall have sufficient capacity and torque to start, accelerate, and operate the machine it drives without exceeding the motor nameplate rating at the speed specified, or at any speed and load which may be obtained by the drive actually furnished.

B. Starting: Each automatically controlled motor shall be capable of starting as frequently as the control sequence may demand. Motors not automatically controlled shall be capable of making no fewer than 4 starts per hour.

C. Loads: Belt-connected motors shall be equipped with shafts and bearings designed to withstand both the normal connected loads of the drive furnished, and momentary loads imposed during acceleration.

D. Ratings: Motors shall be rated for continuous duty at 100 percent of rated capacity, and temperature rise shall be based on ambient temperature of 40 degrees C.

E. Phase: Unless otherwise indicated, motors one-half horsepower and larger shall be polyphase and motors smaller than one-half horsepower shall be single-phase motors.

F. Motor construction:

1. Motors for fans, air handling units, and pumps, unless specified otherwise in the equipment section, shall be open drip-proof NEMA design B construction.

G. Efficiency: The term “energy efficient” is defined in the article “Definitions” in Part 1 above.

1. Single-phase motors, alternating-current fractional horsepower, rated 1/20 to 1 horsepower, 250 volts or less: NEMA MG 11, types and efficiencies selected for their applications.
2. Polyphase motors, medium alternating-current, squirrel-cage, 1 to 500 horsepower, 600 volts or less: NEMA MG 10, energy-efficient types selected for their application. Nominal full-load efficiencies shall meet or exceed ratings of Table 12-10 of NEMA MG 1.

3. Motors for packaged hermetic and semi-hermetic refrigeration compressors need not comply with these efficiency requirements but they shall comply with the requirements indicated for power factor and power consumption.

2.3 SINGLE-PHASE MOTORS

A. Permanent split-capacitor or split-phase type.

B. Bearings: Sealed, prelubricated ball-bearing type.

2.4 POLYPHASE MOTORS

A. NEMA MG1 Design B.

B. Stator: Copper windings.

C. Rotor: Squirrel cage.

D. Bearings: Doubly shielded, prelubricated ball bearings suitable for radial and thrust loading of connected equipment.

E. Temperature rise shall not exceed insulation rating.

F. Insulation: Class F.

G. Motors used with inrush controllers: Match wiring requirements for indicated controller with required motor leads brought to motor terminal box to suit control method.


I. Motor frame and endshields: Cast iron.

J. Conduit box: Either steel or aluminum, diagonally split and rotatable in 90-degree increments, with grounding provision.

K. Finishes:

1. External hardware: Plated to resist corrosion.
2. External paint: Industrial enamel.
L. Nameplates: Stainless steel or aluminum, and stamped in accordance with NEMA MG1. Nameplate information shall include the nominal efficiency value in accordance with NEMA MG1 and the manufacturer’s minimum guaranteed efficiency value.

2.5 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Brushless direct current (DC) variable speed motor supplied with alternating current, with a permanent magnet with near zero rotor losses, permanently-lubricated ball bearings, electronic commutation, designed for synchronous rotation, and at least 70 percent efficient at all operating speeds.

B. As a minimum, the motor shall include the following features:

1. Integrated controller / inverter that operates the wound stator and senses rotor position to electronically commutate the stator.
2. Thermal overload protection.
4. Inductors to minimize harmonic distortion and line noise.
5. Designed to overcome reverse rotation without affecting life expectancy.
6. Motor speed shall be controllable down to 20 percent of full speed. Speed shall be controlled by either a potentiometer with manual adjustment on the motor or by a 0-10Vdc analog signal from a remote source, as required by other sections of Division 23 specifications.
7. Software for motor control shall be as indicated or described in other Division 23 specifications.

2.6 MOTORS CONTROLLED BY VARIABLE FREQUENCY DRIVES

A. Specifically constructed and warranted by the manufacturer to meet the voltage requirements of NEMA MG 1, Part 31.4.4.2.

B. Temperature rise: Match rating for Class B insulation.

C. Insulation: Class B or F (TEFC), or Class F (ODP).

D. Bearing protection: Conductive shaft grounding ring, equal to Aegis SGR by Electro Static Technology, to transmit induced current from shaft to motor frame without harming bearings.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Mount direct-connected motors securely and in accurate alignment. The drive shall be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

B. Provide each belt-connected motor with a securely mounted adjustable base to permit installation and adjustment of belts.

C. Mount capacitors shipped separately beside motor connection box as required. Connect in accordance with the requirements of Division 26, Electrical.

   1. Test units at full rated load after the installation of the motor capacitors, and submit reports.

D. Provide additional drive and belt changes where required to meet requirements of testing and balancing specified in Section 23 05 93, Testing, Adjusting and Balancing.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

END OF SECTION
SECTION 23 05 19 - METERS AND GAUGES FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Meters and gauges for HVAC systems.

1.2 RELATED SECTIONS

A. Pipe installation and testing: Section 23 05 00.

B. Valve tags and charts: Section 23 05 23.

1.3 SUBMITTALS

A. Shop drawings: Meter and gauge schedule showing manufacturer’s figure number, scale range, location, and accessories for each meter and gauge.

B. Product data: For each type of meter, gauge, device, and fitting specified.

1. Scale range.
2. Ratings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Meters and gauges:

1. AMETEK; U.S. Gauge
2. Ashcroft; Dresser Instrument
3. Miljoco Corporation
4. Taco, Inc.
5. H.O. Trerice Co.
6. Weiss Instruments
7. Weksler; Dresser Instrument

B. Pressure-temperature connections:

1. Miljoco Corporation
2. Peterson Equipment Company
3. Sisco
4. Texas Fairfax Company
2.2 THERMOMETERS

A. General: Industrial, adjustable angle type, accurate to within plus or minus one percent of range span, baked enamel finish, blue reading organic liquid tube, glass or clear acrylic plastic window, dust and moisture tight.

1. Scale size: 9 inches (230 mm).
2. Graduation: To the scale shown on the drawings or of a scale so that the normal working temperature of the system is near the mid-point of the scale.

B. Pipe-mounted thermometers: Brass well, separable sockets.

1. Where mounted in insulated piping, thermometers shall have six-inch (150-mm) stem length and sockets with 2.5-inch (64-mm) lagging extension necks. Where mounted in uninsulated piping, they shall have 3.5-inch (89-mm) stem lengths and sockets without lagging extension.
2. Where thermometer wells only are required, provide separable socket with 2.5-inch (64-mm) lagging extension, fitted with attached chain and cap.

C. Duct-mounted thermometers: Perforated aluminum stem, length maximum 24 inches (610 mm) or of length to have end of bulb near center of duct. Provide union flange fitting where stem passes through duct side or unit casing. Provide lagging extension flange on insulated ductwork.

2.3 PRESSURE GAUGES

A. Pressure gauges shall be accurate to within plus or minus one percent of range span, silver brazed bronze bourdon-tube system, bronze movement, aluminum dial with white background, black graduations and numerals and adjustable pointer, bottom connected.

1. Dial diameter: 6 inches (150 mm).
2. Those installed adjacent to pumps or in pulsating locations shall be provided with pulsating dampeners or snubbers.
3. Case: Cast aluminum or glass filled nylon.

B. Graduation: To the scale shown on drawings, or so pointer is nearly straight up at system normal working pressure.

C. Gauges shall be straight pressure type, except gauges on suction side of pumps and inlet side of suction strainers shall be compound type.
D. Gauge cock (pressure gauge isolation valve):

2. Ball valve: Bronze, three-piece body, full port, with Type 316 stainless steel trim, 150 psi (1034 kPa) saturated steam, 600 psi (4137 kPa) non-shock cold water, oil, or gas, equal to Nibco 595.

E. Pressure gauge for fuel gas service: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gauge, with bottom connection, designed for pressure 10 psi (69 kPa) and less with 1/10 of 1 psi increments; equal to Trerice No. 760B.

1. Case: Drawn steel or brass, with 2.5-inch (64-mm) diameter glass lens.
2. Connector: Brass, 0.25-inch (DN 8) NPS.
3. Scale: White coated aluminum, with black graduations and markings.
4. Accuracy: Plus or minus 1.6 percent of range.

2.4 COMBINATION PRESSURE-TEMPERATURE CONNECTIONS

A. Combination pressure-temperature connections: Equal to UMAC Universal Lancaster Test Plugs, Peterson “Pete’s Plug,” Sisco, Fairfax P/T Plugs, H.O. Trerice test plugs, or Miljoco test plugs. Plugs shall have self-closing valve which will operate at a temperature up to 300 degrees F (149 degrees C). Body and cap shall be brass, and shall receive either a temperature or pressure probe. Provide with a kit including gauges and thermometers in a protective case.

PART 3 - EXECUTION

3.1 INSTALLING THERMOMETERS

A. Pipe line thermometers shall be installed as indicated on the drawings.

B. Duct thermometers for air handling units shall be located as follows, except thermometers are not required if air system is not ducted:

1. Draw-through units: (4 per unit)
   a. OA duct: rigid bulb, minus 20 to plus 130 degrees F (minus 28.9 to plus 54.4 degrees C).
   b. RA duct: rigid bulb, plus 30 to 180 degrees F (minus 1.1 to plus 82.2 degrees C).
   c. Discharge duct: rigid bulb, plus 30 to 180 degrees F (minus 1.1 to plus 82.2 degrees C).
   d. Mixed air plenum: rigid bulb, plus 30 to 180 degrees F (minus 1.1 to plus 82.2 degrees C) (on discharge side of filter).
C. Units made up of fan section, filter section, and duct-mounted coils shall be provided with thermometers the same as draw-through units.

D. Furnish and deliver to Owner at final inspection, three additional pipe line thermometers as above specified, with 6-inch (152-mm) stem lengths, for use in the thermometer wells. Ranges shall be minus 40 to plus 110 degrees F (minus 40 to 43.3 degrees C); 20 to 120 degrees F (minus 6.7 to 48.9 degrees C), and 50 to 550 degrees F (10 to 287.8 degrees C).

3.2 INSTALLING PRESSURE GAUGES

A. Each gauge connection shall have a gauge cock. Connections to pipe lines shall be 0.5 inch (DN 15), with 0.5 inch (DN 15) by 0.25 inch (DN 8) reducer for valve, the assembly of sufficient length to clear insulation.

B. Where gauge cocks only are called for on drawings, provide the 0.5-inch (DN 15) connections to pipe line with reducer and the gauge cock.

C. Provide one compound and one straight pressure gauge of appropriate scale to Owner at final inspection.

3.3 INSTALLING COMBINATION PRESSURE-TEMPERATURE CONNECTIONS

A. Option: Provide combination pressure-temperature connections, complete with kits, where thermometer wells or gauge cocks only are called for on the drawings.

END OF SECTION
SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

   A. Valves for various piping systems.

1.2 RELATED SECTIONS

   A. Piping installation and testing: Section 23 05 00.
   B. Piping systems: Sections 23 21 13.
   C. Automatically operating valves: Section 23 05 08.

1.3 REFERENCES

   A. ASME B16.10: Face-to-Face and End-to-End Dimensions of Valves.
   B. ASME B16.34: Valves - Flanged, Threaded, and Welding End.

1.4 SUBMITTALS

   A. Product data: For each type of valve. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

   B. Maintenance data: For inclusion in operation and maintenance manual specified in Division 01 and Section 23 01 01. Include manufacturer’s instructions for adjusting, servicing, disassembling, and repairing.

   C. Valve charts: Furnish valve charts typed on 8.5 by 11-inch (216 by 279-mm) bond paper, showing locations of all manual and automatic control valves, and flow meters. Include:

      1. Number
      2. Location
      3. Service
      4. Function
      5. Area served
D. Valve numbering system shall be approved by the Owner prior to final submittal. Place one copy of approved chart in a plastic envelope and mount on wall where directed. Provide another copy for each of the Operating and Maintenance Manuals.

1.5 QUALITY ASSURANCE

A. Ferrous valves shall conform to ASME B16.10 and B16.34 for dimension and design criteria.

B. Copper alloy valves (brass and bronze) shall have no more than 15 percent zinc in the alloy.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Gate and globe valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following:

1. Crane Co.
2. Hammond Valve Co.
3. Lunkenheimer Co.
4. Milwaukee Valve Co.
5. NIBCO
6. Stockham Valve & Fittings
7. Walworth Co.

B. Ball valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following:

1. Apollo Valves
2. Milwaukee Valve Co.
3. NIBCO
4. Stockham Valve & Fittings
5. Victaulic Company of America
6. Walworth Co.
7. Watts Regulator Co.

C. Butterfly valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following:

1. Apollo Valves
2. Centerline - Mark Controls Corporation
3. DeZurik
4. Keystone
5. Milwaukee Valve Co.
6. NIBCO
7. Victaulic Company of America
8. Walworth Inc.

D. Check valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following:

1. Combination Pump and Valve Co.
2. Mueller Steam Specialty
3. NIBCO
4. Victaulic Company of America

E. Balancing valves: Subject to compliance with requirements, provide specified venturi ball valve (readable) by Flo-Pac or NuTech Hydronic Specialty Products, or comparable product by one of the following:

1. IMI Flow Design
2. Gerand Engineering
3. Griswold Controls
4. Pro Hydronic Specialties
5. Taco
6. Tour & Andersson

F. Drain valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following:

1. Apollo Valves
2. Milwaukee Valve Co.
3. NIBCO
4. Stockham Valve & Fittings
5. Victaulic Company of America
6. Walworth Co.
7. Watts Regulator Co.

2.2 VALVES

A. Gate valves:

1. Valves NPS 2 and smaller; Class 150, bronze construction; rising stem, solid wedge, NIBCO T-134 or S-134, threaded or soldered ends.
2. Valves NPS 2.5 and larger; Class 125, IBBM, OS & Y, solid wedge, bronze-mounted, bolted bonnet, NIBCO F-617-0, flanged ends.

B. Ball valves:
1. Valves NPS 2 (DN 50) and smaller: Class 150 SWP, bronze, two-piece body, full port, TFE seats and seals, stainless-steel ball and stem. Extension handle for use in insulated piping. NIBCO T-585-70-66 or S-585-70-66, threaded or soldered ends.

   a. Valves NPS 2.5 to 3 (DN 65 to 80): Conventional port, NIBCO T-580-70-66 or S-580-70-66, threaded or soldered ends.

2. Valves NPS 4 (DN 100) and larger: Class 150 SWP, carbon steel body, one-piece flanged construction, conventional port, stainless-steel ball and stem, TFE seat and packing. Extension handle for use in insulated piping. NIBCO F-510 series.

C. Butterfly valves, NPS 2.5 (DN 65) and larger: Bubble-tight shutoff in both directions at 200 psi (1379 kPa), and maintains bubble-tight rating when flange on one side is removed (dead-end service); Class 150 suitable for use with ASME B16.5 Class 125 and 150 flanges; ASTM A 536 ductile-iron lug body, stainless-steel stem; field-replaceable EPDM sleeve and stem seals, capable of withstanding 225 degrees F (107 degrees C); equal to NIBCO LD-2000.

1. Disk type: Aluminum bronze
2. Operator:
   a. NPS 6 (DN 150) and smaller: Ten-position leverlock handle.
   b. NPS 8 (DN 200) and larger: Gear operator.

3. Provide extension handle where required in insulated piping.
4. Where used for balancing, provide memory stop.

D. Globe valves:

1. Valves NPS 2 (DN 50) and smaller: Class 125, bronze, teflon seat disk, screw-in bonnet, NIBCO Fig. T-211-Y or S-211-Y, threaded or soldered ends.
2. Valves NPS 2.5 (DN 65) and larger: Class 125, cast-iron disk, bolted bonnet, NIBCO Fig. F-718-B, flanged ends.
3. Angle-type valves NPS 2 (DN 50) and smaller: Class 125, bronze, Teflon seat disk, screw-in bonnet, NIBCO T-311- Y or S-311-Y, threaded or soldered ends.
4. Angle-type valves NPS 2.5 (DN 65) through NPS 8 (DN 200): Class 125, IBBM, bronze or bronze-faced disk, bolted bonnet, NIBCO F-818-B, flanged ends.

E. Center-guided, spring-loaded silent-action type check valves:

1. Valves NPS 2 (DN 50) and smaller: Class 125, bronze body, Teflon disk, Teflon seat ring, stainless-steel stem and spring, NIBCO Fig. S-480Y or T-480-Y, threaded or soldered ends.
2. Valves NPS 2.5 (DN 65) through NPS 10 (DN 250): Class 125, cast-iron body, bronze trim, stainless-steel spring, NIBCO Fig. W-910, wafer style.
3. Valves NPS 12 (DN 300) and larger: Class 125, cast-iron body, stainless-steel spring, NIBCO Fig. F-910, flanged.

F. Swing check valves:

1. Valves NPS 2 (DN 50) and smaller: Class 125, bronze, PTFE seat, renewable disks, Y pattern, horizontal swing, NIBCO T-413-Y or S-413-Y, threaded or soldered ends.
2. Valves NPS 2.5 (DN 65) and larger: Class 125, IBBM, bolted bonnet, renewable seat and disk, horizontal swing NIBCO Fig. F-918-B, flanged ends.

G. Balancing valves:

1. NPS 2 (DN 50) and smaller: Venturi ball valve (readable valve) with threaded or soldered ends, Flo-Pac or Nutech Hydronic Specialty Products Model MB, Taco “Accu-Flo (ACUF),” Gerard “Balvalve-Ventur (BV),” Tour & Andersson STAD Series, Griswold Controls “QuickSet,” IMI Flow Design Model UA or Pro Hydronic Specialties Model CBV.
   a. Materials: Brass and bronze body, chrome-plated brass ball, PTFE seats and stem packing.
   b. Ratings: Entire assembly 30 psi, 250 degrees F (1725 kPa, 121 degrees C).
   c. Flow element: Low-loss, high-signal venturi section with schrader or quick-connect pressure-ports, reliability one to ten and accuracy 2 percent.
   d. Stem: Blowout-proof.
   e. Memory stop: On valve section, adjustable, with extended handle.
   f. Bellows type meter gauge kit with case, provide one for use on the entire project.
2. NPS 2.5 (DN 65) and larger: Butterfly valve with memory stop coupled with a venturi flow-measuring assembly.
   a. Venturi type flow element: Low-loss, high-signal venturi with schrader or quick-connect pressure ports, accuracy plus or minus 3 percent FS.
   b. Provide Owner, one bellows-type meter gauge kit with case for use on the entire project.

2.3 DRAIN VALVES

A. Two-piece full-port ball valve, NPS 0.75 (DN 20), 600 psi (4137 kPa) CWP, 400 deg F (204 deg C) maximum operating temperature, bronze body, PTFE seats and seals, chrome-plated brass ball, threaded hose outlet with brass cap and chain, lever handle. Provide extension handle where used in insulated piping. NIBCO T-585-70-HC or S-585-70-HC; threaded or soldered inlet.

1. Provide a removable handle where valve is accessible to the general public.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install valves to be readily accessible for operation and maintenance, and with ample clearance for turning handles or operators.

B. For valves in inaccessible locations, provide access doors as specified in a related section.

C. Identify valves as specified in Section 23 05 00, Common Work Results for HVAC.
   1. Provide tags for all valves except stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.
   2. Provide ceiling identification tags where valves are above an accessible suspended ceiling. Number shall correspond to tag number.

3.2 INSTALLING SHUTOFF AND BALANCING VALVES

A. Install shutoff and balancing valves where indicated. Generally, install balancing valves in return lines of heating coils and elements, and shutoff valves in supply lines.

B. Shutoff valves for water piping systems shall be as follows:
   1. Sizes NPS 2 (DN 50) and smaller: Gate or ball valves.
   2. Sizes NPS 2.5 (DN 65) and larger: Gate or butterfly valves.

C. Balancing valves: Locate valve to provide 5 pipe diameters straight inlet and 2 pipe diameters straight outlet.

3.3 INSTALLING GLOBE AND CHECK VALVES

A. Provide globe valves where indicated.

B. Provide center-guided, spring-loaded silent-action type check valves in pumped lines, lines subject to pump pressure, and vertical lines.

3.4 INSTALLING DRAIN VALVES

A. Install drain valves, NPS 0.75 (DN 20) or size indicated on the drawings, at every low point of a water system, and where indicated.

END OF SECTION
SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe hangers and supports.
B. Trapeze pipe hangers.
C. Metal framing systems.
D. Insulation protection.
E. Fasteners.
F. Equipment foundations and supports.

1.2 RELATED SECTIONS

A. Vibration control supports: Section 23 05 48.
B. HVAC Piping Insulation: Section 23 07 19
C. Duct supports: Section 23 31 13.

1.3 REFERENCES

A. American Society of Mechanical Engineers
   2. ASME B31.9: Building Services Piping.
B. ASTM International
   1. ASTM A 36: Standard Specification for Carbon Structural Steel
   2. ASTM A 53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   3. ASTM A 307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
   4. ASTM A 1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
5. ASTM C 533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
8. ASTM F 3125: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

C. American Welding Society
   1. AWS-D.1.1: Structural Welding – Steel

D. Metal Framing Manufacturer’s Association
   1. MFMA-4: Metal Framing Standards Publication
   2. MFMA-103: Guidelines for the Use of Metal Framing

E. Manufacturer’s Standardization Society
   1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

1.4 DEFINITIONS

A. High Temperature Hot Systems: Operating temperatures 200 degrees F (93 degrees C) and above.

B. Hot Systems: Operating temperatures 120 degrees F (49 degrees C) to 200 degrees F (93 degrees C).

C. Ambient Systems: Operating temperatures 60 to 119 degrees F (16 to 48 degrees C).

D. Cold Systems: Minimum operating temperatures 59 degrees F (15 degrees C) and below.

1.5 SUBMITTALS

A. Product data:
   1. Provide manufacturer’s literature showing compliance with specifications for each type of hanger, framing system, support, fastener and accessory materials.
   2. Provide a schedule of piping types and sizes and associated pipe hanger types.
   3. Provide a schedule of building attachment types and associated attachment hardware.
   4. Provide a schedule of pipe types and sizes and proposed hanger spacing and support rod diameters.
B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Qualifications of welders: As specified in Section 23 05 00, Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Pipe hangers:
   1. Anvil International
   2. Carpenter and Paterson, Inc.
   3. Cooper Industries
   4. National Pipe Hanger Corporation
   5. PHD Manufacturing, Inc.
   6. PHP Systems/Design

B. Metal framing systems:
   1. Anvil International
   2. Cooper Industries
   3. Hydra-Zorb
   4. PHD Manufacturing, Inc.
   5. PHP Systems/Design
   6. Unistrut

C. Pipe covering protection shields:
   1. Anvil International
   2. Carpenter and Patterson, Inc.
   3. Cooper Industries
   4. National Pipe Hanger Corporation
   5. PHD Manufacturing, Inc.
   6. Pipe Shields, Inc.
   7. Rilco Manufacturing Co., Inc.

2.2 PIPE HANGERS AND SUPPORTS

A. General: Comply with requirements of MSS SP-58.

B. Hangers and clamps:
2. Typical interior applications: Galvanized steel or factory painted.
4. For use with uninsulated copper pipe: Copper plated.

C. Trapeze pipe hanger: MSS SP-58, Type 59, shop-fabricated or field-fabricated pipe support assembly made from structural carbon-steel shapes with pipe saddles and U-bolts to secure piping on top of hanger.

D. Supplemental materials:

1. Threaded rod: Continuously threaded.
   a. Zinc-plated or galvanized carbon steel for indoor applications.
   b. Stainless steel for outdoor and corrosive applications.

2. Nuts and washers: Provide the same material used for threaded rods.
4. Steel pipe: ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40, black and galvanized steel.

E. Metal framing systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of channels, nuts, bolts, structural connections, accessories, fittings, and other manufactured components.
2. Standard: Comply with MFMA-4 for factory-fabricated components for field assembly.
3. Channels: Continuous slotted galvanized steel channel with inturned lips, width selected for applicable load criteria.
4. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Metal framing system pipe clamps:
   a. Galvanized steel clamp pipe support with elastic stop nut, and hex head machine screw, and manufactured to connect to metal framing system channels.
   b. For insulated piping: Clamp shall have friction tape on inside of clamp surface, manufactured to connect to pipe clamp insulating insert over pipe.
   c. For uninsulated piping: Clamp shall have an integral molded thermoplastic elastomer clamping insert on inside of clamp surface, manufactured to connect to uninsulated pipe.

F. Insulation protection:

1. Pipe covering protection shield:
a. Shield: Galvanized steel, meeting the requirements of MSS SP-58 Type 40. Provide with alignment ridges when used in conjunction with pipe hanger.
b. Structural insulation insert: Structural insulation insert to form the insulation for the lower half of the pipe circumference. Provide Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.

2. Combination insulating insert and insulation protection shield:
   a. Insulating insert material for cold and ambient system piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa); or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier. Insert thickness shall match adjacent piping insulation thickness.
   b. Insulating insert material for hot system piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa); ASTM C 552, Type II cellular glass with 100-psig (688-kPa); or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.
   c. Insulation protection shield: Galvanized steel.

3. Pipe covering protection saddle:
   a. Saddle: Steel, meeting requirements of MSS SP-58 Type 39
   b. Insulation insert: Insulating material located in the space between saddle and pipe.

4. Pipe clamp insulating insert:
   a. Insulating insert material: Closed-cell, sponge or expanded rubber, ASTM C 534, Type I for tubing material, with integral supports constructed from non-compressive closed cell material, single piece construction with self-adhesive closure strips. Insert thickness shall match adjacent piping insulation thickness. If insulation thickness is not available, provide maximum available thickness and seal insulation vapor barrier at thickness transition.
   b. Insulation protection jacket: Aluminum or stainless steel, bonded to insulation insert.
   c. Insulating insert and jacket shall cover entire circumference of pipe.
   d. Equal to Armacell “Armafix” insulating inserts.

2.3 FASTENERS
A. Mechanical expansion anchors: Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes, equal to ITT Phillips Anchors “Red Head.” Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer’s stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications.

B. Fasteners to drywall or cavity wall construction: Equal to ITT Phillips Anchors “Red Head” toggle bolts, with hollow wall drive anchors or nylon anchors as required.

C. Fasteners to wood construction: Lag bolts.

D. Bolts, nuts, and washers: ASTM A 307, or ASTM F 3125 where high strength is required.

2.4 CONCRETE AND GROUT

A. Concrete:

1. Concrete shall be no less than 3000-psi (25,000 kPa) strength.
2. Reinforcement: 6 by 6 inch (150 by 150 mm) welded steel wire fabric, ASTM A 1064.

B. Grout:

1. Premixed, non-shrink grout consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi (48,000 kPa) in 28 days.
2. Provide grout by one of the following manufacturers:
   a. Sonneborn-Rexnord “Sonogrout”
   b. L&M Construction Chemical Company “Crystex”
   c. US Grout Corporation “Five-Star Grout”

PART 3 - EXECUTION

3.1 GENERAL

A. Provide hangers and supports in accordance with schedules at the end of this section, as modified by specifications for each location and type.

B. Comply with MSS SP-58. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
C. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Where required, provide structural steel shapes or metal framing system channels and hardware to transfer load from a hanger location to multiple locations in the structure in order to get support from an appropriate location or to increase the strength of the connection to the structure.

E. Support horizontal piping from above with hangers and threaded rod where possible, unless otherwise indicated.

F. Support pipe risers through floor slabs with riser clamps.

G. Provide hanger sizes to allow for continuous insulation for insulated piping systems.

H. Fabricate wall-mounted and floor-mounted supports using metal framing systems or structural steel where required.

I. Support groups of small piping along a structural wall using a metal framing system secured to the wall.

J. Trim threaded rods with a maximum excess length of 1 inch (25 mm). Provide protective rubber red end caps on the ends of threaded rods exposed and within 8 feet (2.4 meters) of the floor, roof, or grade below.

K. 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.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. 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. Coordinate with requirements for hangers that require vibration control. See Section 23 0548.

P. Trapeze pipe hangers: Provide where required for grouping of parallel runs of horizontal piping.
   1. Weld steel according to AWS D-1.1.
   2. Hang with threaded rods. Size threaded rods in accordance with MSS SP-58.
3. Design trapeze pipe hangers and supports based on supported load plus a 50 percent minimum safety factor.
4. Hanger spacing shall not exceed the requirements for the smallest pipe in the rack.
5. Hanger spacing shall not exceed 6 feet (1.8 m) where hung from wood.

Q. Metal framing systems: Provide where required for grouping of parallel runs of piping, and support together on field-assembled strut systems. Comply with MFMA-103 for metal framing system selections and applications.

R. Support exterior piping above unfinished grade with concrete support piers.

3.2 BUILDING ATTACHMENTS:

A. Attaching to structural walls:
   1. Provide a minimum of two 0.375 inch (9.5 mm) minimum screw-type fasteners for attaching brackets and a minimum of three 0.5 inch (13 mm) minimum bolt-type fasteners for attaching structural supports.

B. Attaching to structural steel beams, channels, or angles:
   1. Secure threaded rods to MSS SP-58 Type 20 adjustable beam clamps that are clamped to the bottom flange of steel beams for any pipe size.
   2. Secure threaded rods to MSS SP-58 Type 23 beam clamps for beams with maximum flange thickness of 0.75 inch (19 mm) and for single pipes NPS 2 (DN 50) and smaller.

C. Attaching to bar joists:
   1. Provide MSS SP-58 Type 19 top-beam C-clamps attached to top flange of the joists at panel points.
   2. Piping perpendicular to joists:
      a. Pipes NPS 2.5 (DN 65) and smaller: Support from at least every other joist to spread the load among joists. Where multiple pipes are grouped together, stagger hangers to distribute the load among available joists.
      b. Pipes NPS 3 (DN 80) and larger: Support from every joist to spread the load among joists.
      c. If additional support is required between joists, hang metal framing system channel or structural steel shape from joists using MSS SP-58 Type 19 C-clamps attached to the top flange of two joists, and hang piping from metal framing system channel or structural steel shape.
   3. Piping parallel to joists:
a. Hang metal framing system channel or structural steel shape from joists using MSS SP-58 Type 19 C-clamps attached to the top flange of two joists. Hang piping from metal framing system channel or structural steel shape.

b. For pipes NPS 2.5 (DN 65) and smaller: A single pipe may be hung from a single joist.

D. Attaching to concrete slabs and composite slabs:

1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting pipe from concrete slabs or composite slabs. Where approved, provide mechanical expansion anchors and steel bolts or rods.

E. Attaching to precast concrete hollow core plank:

1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting pipe from precast concrete plank.

2. Floor construction with topping slab:

   a. Threaded rods shall pass through the plank and be secured on topside with nut, locknut, and plate washer.
   b. Plate washers: 4 by 8 inches by 0.125 inch thick (100 mm by 200 mm by 6 mm) thick for 0.375-inch and 0.5-inch (10-mm and 15-mm) rods; 6 by 12 inches by 0.187 inch thick (150 by 305 by 5 mm) for 0.625-inch (16-mm) and larger rods.
   c. Top of hanger assembly shall be concealed below surface of topping slab.
   d. Drill openings through precast planks for the passage of threaded rods with power-driven carbide-tip drills, in accordance with Architect’s instructions. Do not cut reinforcing bar without specific approval of the Structural Engineer.

3. Existing floor construction:

   a. Provide toggle bolts, or remove and repair topping slab and support pipe as indicated above.

4. Roof construction:

   a. Provide toggle bolts.

5. Where several pipes are run in parallel, stagger individual hangers to avoid concentrating the load on a single plank.

6. Provide supplemental steel with connections to multiple planks where required to spread a load among multiple planks.

F. Attaching to precast concrete tees:
1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting pipe from concrete tees. Support piping according to the tee manufacturer’s recommendations.

G. Attaching to steel decks: Not permitted.

H. Attaching to metal grating:

1. Piping perpendicular to structural members supporting grating:
   a. Attach threaded rods to the structural members using MSS SP-58 Type 23 beam clamps.
   b. If intermediate support is needed for proper hanger spacing, attach additional threaded rods to 2.5 by 2.5 by 0.25-inch (90 by 90 by 8-mm) angles, 12 inches (305 mm) long, welded to the underside of the grating.

2. Piping NPS 2 (DN 50) and smaller parallel with structural members supporting grating:
   a. Attach threaded rods to 2.5 by 2.5 by 0.25-inch (90 by 90 by 8-mm) angles, 12 inches (305 mm) long, welded to the underside of the grating for piping between structural members.
   b. Attach threaded rods to the structural members using MSS SP-58 Type 23 beam clamps for piping under structural members.

3. Piping NPS 2.5 (DN 65) and larger parallel with structural members supporting grating:
   a. Support as specified above for bar joist construction.
   b. Hang metal framing system channel or structural steel shape from structural members using MSS SP-58 Type 23 beam clamps. Hang piping from metal framing system channel or structural steel shape.

4. Threaded rods shall have locknuts.

I. Attaching to wood construction:

   1. Trusses: Follow roof truss manufacturers’ recommendations for attachment locations, loads, spacing, and methods of attachment.
   2. Joists: Provide MSS SP-58 Type 34 side beam connectors.

3.3 INSTALLING EQUIPMENT FOUNDATIONS AND SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor. Provide lateral bracing, to prevent swaying.
B. Provide minimum four-inch (100-mm) -high concrete foundations (housekeeping pads) or as indicated on drawings, reinforced with welded-wire fabric, for floor-mounted equipment and where indicated. Anchor concrete foundations by dowels inserted into the floor slab.

C. Unless otherwise specified, provide concrete foundations, bolts, sleeves, and appurtenances as work of the section where the supported equipment is specified and in accordance with the requirements of Division 03.

D. Equipment shall be properly aligned and leveled, and grouted where necessary. Support piping independently of equipment and so as not to cause a strain or thrust.

E. Coordinate exact size, configuration and location of equipment, foundations, and supports using approved shop drawings of equipment.

3.4 PIPING HANGER AND SUPPORT SCHEDULES

A. Hot hydronic applications: Applications include, but are not limited to heating water systems, and portions of dual temperature systems that only experience hot conditions.

(See schedule, next page)
<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
<th>Piping applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydra-80</td>
<td>Description</td>
<td>All sizes</td>
</tr>
<tr>
<td>MSS SP-58</td>
<td>Description</td>
<td>All sizes</td>
</tr>
<tr>
<td>MSS SP-70</td>
<td>Description</td>
<td>All sizes</td>
</tr>
<tr>
<td>Supported from Above</td>
<td>Type 1 &amp; 40 Clevis hanger &amp; pipe covering protection shield.</td>
<td>NPS 0.5 (DN 15) through NPS 2 (DN 50)</td>
</tr>
<tr>
<td>Supported from Below</td>
<td>Type 37 Adjustable pipe stanchion saddle with U-bolt and floor flange anchored to floor (with combination insulating insert and insulation protection shield).</td>
<td>All sizes where supported from the floor or a concrete support pier. Use only where no significant horizontal pipe movement is anticipated.</td>
</tr>
<tr>
<td></td>
<td>Types 41 &amp; 39 Adjustable roller support &amp; pipe covering protection saddle (cast-iron roll and sockets, steel roll rod, hung from above with threaded rods).</td>
<td>All sizes where supported from racks, fixed structural supports, or brackets where vertical adjustment is required.</td>
</tr>
<tr>
<td></td>
<td>Types 44 &amp; 39 Roller chair &amp; pipe covering protection saddle (Cast-iron roll, steel roll rod, steel chair, bolts, and hex nuts).</td>
<td>All sizes where supported from racks, fixed structural supports, or brackets where vertical adjustment is not required.</td>
</tr>
<tr>
<td></td>
<td>N/A Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.</td>
<td>NPS 0.5 (DN 15) through NPS 6 (DN 150)</td>
</tr>
<tr>
<td>Risers</td>
<td>Type 8 Riser clamp.</td>
<td>All sizes</td>
</tr>
</tbody>
</table>
B. Uninsulated hydronic applications and other uninsulated: Applications include, but are not limited to non-geothermal heat pump systems, gas piping, and fuel oil piping.

<table>
<thead>
<tr>
<th>MSS SP-58 Classification</th>
<th>Description</th>
<th>Piping applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hung from Above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 1</td>
<td>Clevis hanger</td>
<td>All sizes</td>
</tr>
<tr>
<td>Type 10</td>
<td>Adjustable swivel ring</td>
<td>NPS 0.5 (DN 15) thru NPS 4 (DN 100)</td>
</tr>
<tr>
<td>Type 59</td>
<td>Trapeze pipe hanger with pipe saddles &amp; U-bolts.</td>
<td>NPS 0.5 (DN 15) thru NPS 4 (DN 100)</td>
</tr>
<tr>
<td>N/A</td>
<td>Metal framing system with metal framing system pipe clamps for uninsulated piping.</td>
<td>NPS 0.5 (DN 15) thru NPS 4 (DN 100)</td>
</tr>
<tr>
<td>Supported from Below</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 37</td>
<td>Adjustable pipe stanchion saddle with U-bolt, with floor flange and base anchored to floor.</td>
<td>All sizes where supported from the floor or a concrete support pier.</td>
</tr>
<tr>
<td>Type 41</td>
<td>Adjustable roller support (cast-iron roll and sockets, steel roll rod, supported from below with threaded rods).</td>
<td>All sizes where supported from racks, fixed structural supports, or brackets where vertical adjustment is required.</td>
</tr>
<tr>
<td>Type 44</td>
<td>Roller chair (cast-iron roll, steel roll rod, steel chair, bolts, and hex nuts).</td>
<td>All sizes where supported from racks, fixed structural supports, or brackets where vertical adjustment is not required.</td>
</tr>
<tr>
<td>N/A</td>
<td>Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.</td>
<td>NPS 0.5 (DN 15) thru NPS 8 (DN 200)</td>
</tr>
<tr>
<td>Risers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 8</td>
<td>Riser clamp.</td>
<td>All sizes</td>
</tr>
</tbody>
</table>
C. Refrigerant piping applications:

| HANGERS & SUPPORTS FOR REFRIGERANT PIPING APPLICATIONS |
|-----------------------------------------------|------------------|
| MSS SP-58 Classification | Description | Piping applications |
| Hung from Above | | |
| N/A | Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts. | All sizes. |
| Supported from Below | | |
| N/A | Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts. | All sizes |
| Risers | | |
| Type 8 | Riser clamp. | All sizes |

D. Minimum threaded rod sizes: Provide at least the following minimum rod diameters for single rods supporting a single pipe hanger.

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MINIMUM ROD DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPS 2 (DN 50) and below</td>
<td>0.375 inches (10 mm)</td>
</tr>
<tr>
<td>NPS 2.5 and NPS 3 (DN 65 and DN 75)</td>
<td>0.5 inches (15 mm)</td>
</tr>
</tbody>
</table>

E. Maximum hanger and support spacing: Provide additional hangers or supports for concentrated loads such as flanges, valves, expansion compensators, fittings, and other specialties.

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>COPPER HYDRONIC PIPING</th>
<th>STEEL HYDRONIC PIPING</th>
<th>STEEL STEAM PIPING</th>
<th>PLASTIC HYDRONIC PIPING</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPS 0.75 (DN 20) and below</td>
<td>5 feet (1.5 m)</td>
<td>7 feet (2.1 m)</td>
<td>9 feet (2.7 m)</td>
<td>3 feet (0.9 m)</td>
</tr>
<tr>
<td>NPS 1 (DN 25)</td>
<td>6 feet (1.8 m)</td>
<td>9 feet (2.7 m)</td>
<td>12 feet (3.7 m)</td>
<td></td>
</tr>
<tr>
<td>NPS 1.25 (DN 32)</td>
<td>7 feet (2.1 m)</td>
<td>10 feet (3.0 m)</td>
<td>13 feet (4.0 m)</td>
<td></td>
</tr>
<tr>
<td>NPS 1.5 (DN 40)</td>
<td>8 feet (2.4 m)</td>
<td>9 feet (2.7 m)</td>
<td>12 feet (3.7 m)</td>
<td></td>
</tr>
<tr>
<td>NPS 2 (DN 50)</td>
<td>10 feet (3.0 m)</td>
<td>10 feet (3.0 m)</td>
<td>13 feet (4.0 m)</td>
<td></td>
</tr>
<tr>
<td>NPS 2.5 (DN 65)</td>
<td>9 feet (2.7 m)</td>
<td>11 feet (3.4 m)</td>
<td>14 feet (4.3 m)</td>
<td>4 feet (1.2 m)</td>
</tr>
<tr>
<td>NPS 3 (DN 75)</td>
<td>10 feet (3.0 m)</td>
<td>12 feet (3.7 m)</td>
<td>15 feet (4.6 m)</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 23 05 48 - VIBRATION CONTROL SUPPORTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vibration control supports for HVAC equipment.

1.2 RELATED SECTIONS

A. Hangers and supports: Section 23 05 29.
B. Flexible pipe connections: Section 23 05 08.
C. Flexible duct connections: Section 23 33 00.

1.3 SUBMITTALS

A. Product data: For each type of vibration control support included in the work.
   1. For Specification D hanger, include scaled drawing showing degrees of hanger rod swing.
B. Shop drawings: Custom-fabricated supports.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Mason Industries product, or comparable product by one of the following:

   1. Amber/Booth Company, Inc.
   2. Kinetics Noise Control
   3. Mason Industries
   4. Vibro-Acoustics
   6. Vibration Mountings and Controls, Inc.

2.2 VIBRATION CONTROL SUPPORTS

A. Provide engineered supports for equipment and locations shown on drawings and specified in Part 3 below. The units shall prevent the transmission of vibration and mechanically transmitted sound to the building structure.
1. Select units in accordance with the weight distribution of the equipment, so as to produce reasonably uniform deflection. Deflections shall be as specified.
2. Units installed on exterior shall be galvanized.

B. Specification B: Equal to Mason Industries SLFH, free-standing spring isolators, laterally stable without housing, and with 0.5-inch-(13-mm) thick neoprene pads between baseplate and support.

1. Mountings shall have leveling bolts rigidly bolted to equipment.
2. Springs: Spring diameters shall not be less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal of 50 percent of the rated deflection.

C. Specification D: Equal to Mason Industries Type 30N hangers, combination spring and minimum 0.3-inch (8-mm) deflection neoprene in series.

1. Neoprene element: Molded with a rod isolation bushing that passes through the hanger box.
2. Spring diameters and hanger box lower hole sizes: Large enough to permit the hanger rod to swing through a 30-degree arc before contacting the edges of the hole.
3. Springs shall have a minimum additional travel to solid equal to 50 percent of rated deflection.

D. Specification E: Equal to Mason Industries Type PC30N, same as Specification D, except with adjustment to transfer load to spring while holding supported object at fixed elevation. Include spring deflection indicator.

E. Specification W: Neoprene waffle pads made from identical grids molded back to back, square waffle pattern with modular cutting seams to facilitate cutting pads to size in the field without the need for measuring, durometer stiffness as required for uniform loading over pad area and to support equipment weight, provide load-bearing metal plates adhered to pads where required to support large loads.

F. Specification X: Equal to Mason Industries WB, horizontal thrust restraint, consisting of a spring element in series with a neoprene pad as described in Specification B with the same deflection specified for the mountings or hangers.

1. Spring element: Contained within a steel frame and designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 0.25 inch (6 mm) movement at start and stop.
2. Furnish the assembly with one rod and angle brackets for attachment to both the equipment and ductwork or the equipment and the structure.
3. Horizontal restraints: Attached at the centerline of thrust and symmetrically on either side of the unit.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Adjust vibration control supports as recommended by manufacturer to eliminate transmission of vibration to building structure or other systems.

B. Replace springs that become permanently deformed with new springs.

C. Provide 0.25-inch (6-mm) structural plate sized as required between isolator and equipment.

3.2 FAN VIBRATION CONTROL

A. Suspended from structure: Provide Specification D hanger, selected for weight, with minimum 1.0 inch static deflection.

3.3 AIR-HANDLING UNIT VIBRATION CONTROL

A. Isolators for air handling units may be provided as part of the unit (internal isolation) as specified in the section, Air Handling Units with Coils, but shall meet the requirements of this section.

B. On floors above grade and on roofs: Provide number of Specification B mountings, having at least 1.75 inch (45 mm) static deflection, required to properly support unit and its accessories as recommended by the air-handling unit manufacturer.

1. Unit with fan section isolated from coil and filter section:

   a. Provide the Specification B mounting under fan and motor only, bolted to equipment support (housekeeping pad).
   b. Provide Specification X mounts on each side between fan and coil section to control fan section thrust upon fan start-up.

3.4 REFRIGERATION COMPRESSOR VIBRATION CONTROL

A. Roof-mounted air-cooled condensing units with compressors: Specification W neoprene pads. Mount and set on equipment support curbs. Coordinate size and location of curbs with equipment manufacturer.

3.5 HUNG VERTICAL IN-LINE PUMP VIBRATION CONTROL

A. Provide Specification E vibration control supports

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall engage and the Architect shall approve an independent balancing and testing subcontractor.

B. This section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
   1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Adjusting total HVAC systems to provide indicated quantities.
   4. Setting quantitative performance of HVAC equipment.
   5. Verifying that automatic control devices are functioning properly.
   6. Reporting results of the activities and procedures specified in this section.

1.2 RELATED SECTIONS

A. Testing and adjusting requirements unique to particular systems and equipment are included in the sections that specify those systems and equipment.

B. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment sections.

1.3 PERFORMANCE REQUIREMENTS

A. Select and obtain approval of the testing and balancing subcontractor at the earliest possible time and before beginning ductwork installation.

B. The testing and balancing subcontractor shall visit the job site periodically, beginning with the initial stages of construction of the mechanical systems, and shall ensure that the necessary devices are properly installed so that specified testing and balancing can be performed.

1.4 SUBMITTALS

A. Submit qualifications of testing and balancing subcontractor, as required in article “Quality Assurance” below.
B. Submit certified balance report. In addition to general requirements for submittals, submit three copies of final reports and certificates, bound into a booklet.

1.5 QUALITY ASSURANCE

A. Testing and balancing subcontractor qualifications:

1. Current certified member of the Associated Air Balance Council, or certified by National Environmental Balancing Bureau for air and hydronic systems testing and balancing.
2. Has successfully completed at least five projects of similar size and scope.
3. Not affiliated with any other subcontractor participating in this project. Work performed by the subcontractor shall be limited to testing, adjusting, and balancing HVAC systems.

B. Testing and balancing work shall comply with one of the following standards:


PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Instruments: Approved and properly calibrated.

B. Pyrometer surface temperature measurements may be used for piping system water temperatures where thermometer wells are not provided in the piping.

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Before beginning balancing, ascertain that systems are ready. Verify that filters for regular service are in place, as required in Section 23 41 00, Particulate Air Filtration.

3.2 PREPARATION

A. Witness air duct leakage tests required in Section 23 31 13, Metal Ducts, and advise and approve the methods and instruments used.

B. Using bench-calibrated instruments, field-calibrate pressure gages and dial-type duct thermometers.
3.3 BALANCING OF SYSTEMS, GENERAL

A. Tabulate settings of temperature control devices and ascertain that thermostats, controllers, and valves are set at specified or approved positions. Verify and certify that the sequence of operation for each system is as shown on drawings, specified, or approved.

B. Provide all labor and devices necessary for the testing and balancing work.

3.4 AIR SYSTEMS BALANCING

A. Balance all air distribution, supply, return, exhaust, and outdoor air systems and equipment.

B. Test and adjust fans to deliver design airflow at lowest possible speed. Adjust air-handling equipment to deliver the required air volumes. Note that air quantities scheduled on drawings do not include allowances for duct leakage. Preliminary adjustments of fan speed should be slightly in excess of scheduled airflow delivery. Make adjustments by adjusting adjustable sheaves, changing sheaves and associated belts, changing wiring connections of motors, or adjusting speed controller.

C. Test and adjust system to design airflow requirements to the greatest extent possible. Manual volume dampers in ducts shall be adjusted to obtain required airflow rates at grilles, registers, and diffusers. Dampers integral to airflow devices should be fully open or minimally closed for airflow fine adjustments.

D. Make pitot tube traverse of main supply, return, and outdoor air ducts to obtain total airflow for fan or air-handling unit.

E. Adjust rooms or zones to design airflow (supply, return, and exhaust).

F. Adjust general HVAC systems to design airflow within the following tolerances:

1. Total system supply, return, and exhaust: (design to plus 10 percent).
2. Outdoor air: (minus 5 percent to plus 5 percent).
3. Total supply, return, and exhaust for a room or space: (minus 5 percent to plus 5 percent).
4. Grilles, registers, and diffusers:
   a. One per room or space: (minus 5 percent to plus 5 percent).
   b. Two or more per room or space: (minus 10 percent to plus 10 percent).
G. Laboratory and operating room systems shall be adjusted as close as possible to design airflow. Make the adjustments necessary to provide the designed positive or negative airflow relationships between rooms and spaces. Exhaust airflow from fume hoods shall not be less than airflow indicated.

H. Grilles, registers, and diffusers:

1. Identify each grille, register, and diffuser as to location and area. List manufacturer, type, and size.
2. Identify type of testing equipment used.
3. Test and adjust each grille, register, and diffuser to design airflow. List (design-actual) cfm (cubic meters per minute) and (design-actual) velocity in fpm (meters per second) when applicable.
4. Adjust diffusers, grilles, and registers to minimize drafts. Adjust blades in supply diffuser straightening grids to ensure uniform air distribution across diffuser.
5. Adjust linear slot diffusers to provide throw direction as indicated on the drawings. Unless otherwise noted, discharge pattern shall be horizontal. Where two-way throw is indicated, divide the number of slots equally for each direction.

I. Test and record the following data, as applicable, for air-handling equipment:

1. Manufacturer and model number.
2. Total airflow (design-actual).
3. Return air airflow (design-actual).
4. Outdoor air airflow (design-actual).
5. Total and external static pressure (design-actual). Include static pressure at suction, discharge, and between unit coil and filter components.
6. Entering air temperatures (db heating, db and wb cooling).
7. Leaving air temperatures (db heating, db and wb cooling).
10. Fan speed, rpm (rated-actual).
11. Amperage (rated-actual).

J. In cooperation with the control manufacturer’s representative, set adjustments of automatically operated dampers to operate as specified.

K. Adjust air systems feeding terminal reheat units to deliver design airflow with a maximum static pressure at any unit air inlet not over 0.5 inches wg. Eliminate excess static pressure by slowing fan rpm and modulating duct dampers, and not at the reheat unit where excess noise may result.

3.5 VARIABLE VOLUME SYSTEM BALANCING
A. Balance system air distribution, supply, return, and exhaust including air distribution equipment in accordance with AABC standards for Testing and Balancing Variable Volume systems and as specified below.

B. Static pressure sensor locations shall be in those duct runs which are of the longest equivalent length (greatest friction loss).
   1. Measure the supply duct static pressure at each location.
   2. Monitor each location during the adjusting and balancing to assure proper inlet static pressure is being maintained to the air terminal units.
   3. Determine pressure setpoints at each location and forward data to the control subcontractor.

C. Calibrate supply and return fan variable frequency drives.
   1. Balance system at 100 percent airflow, noting supply and return cfm (L/s) and the resulting cfm (L/s) differential.
   2. Set the system to operate at 50 percent of total supply airflow, noting supply fan motor frequency. Adjust the return fan motor frequency so that the cfm (L/s) differential is the same as at 100 percent airflow.
   3. Set the system to operate at 100 percent outdoor air and traverse the ducts. Adjust outdoor air, return air, and exhaust air dampers to maintain total airflow.
   4. Set duct system static pressure controllers to provide adequate static pressure for the most demanding air terminal unit.
   5. Forward test and setpoint data to the control subcontractor.

D. Determine the static pressure setpoint in mixed entering air plenum of each unit.
   1. Set system to operate at 100 percent airflow.
   2. Balance outdoor and return air dampers to provide minimum outdoor airflow scheduled. Adjust dampers to produce a mixed air plenum static pressure which is within the control range of the sensor provided as specified for the automatic temperature control system. Verify the return fan capacity control and static pressure controls functions throughout the 30 to 100 percent airflow range.
   3. Forward test and setpoint data to the control subcontractor.

E. Balance the secondary duct system and make adjustments to the VAV terminal unit volume regulators. Record the following data:
   1. Terminal unit designation.
   2. Manufacturer, model number, and size.
   3. Minimum primary airflow (design - actual).
   4. Maximum primary airflow (design - actual).
   5. Terminal unit fan airflow (design - actual).
   6. Fan motor speed setting, voltage, and current.
F. Walk through the building and listen for noise generated by the air distribution system. Correct balancing to eliminate excess noise. Report noise not related to balancing.

3.6 HYDRONIC SYSTEMS BALANCING

A. Balance all hydronic piping systems.

B. Adjust and balance the following items listed under the various systems in accordance with the specified standards.

1. Domestic hot water system:
   a. Pump
   b. Return piping for flow to every branch

2. Heating system:
   a. Pump
   b. Unit heater
   c. Air-handling unit
   d. Reheat coil
   e. Cabinet unit heater

C. After the above items have been adjusted and balanced, submit a certified report listing the specification requirements and the operating conditions of these items as follows:

1. Pump:
   a. Flow - gpm
   b. Suction pressure
   c. Discharge pressure
   d. Pressure differential
   e. Total dynamic head
   f. Motor - HP voltage, hertz, phase, design full load amps
   g. Motor - operating line voltage and amperage, overload heater ratings.

2. DX coil:
   a. Suction pressure
   b. Suction line temperature
   c. Entering air - D.B.
   d. Entering air - W.B.
   e. Leaving air - D.B.
   f. Leaving air - W.B.
g. Outdoor air temperature - D.B.

h. Outdoor air temperature - W.B.

3. Heating water coil (such as coils in air-handling units, ducts, VAV units, unit heaters and reheat coils):

   a. Flow - gpm
   b. Entering water temperature
   c. Leaving water temperature
   d. Entering air - D.B.
   e. Leaving air - D.B.

3.7 MARKING OF SETTINGS

   A. Following final balance procedures, permanently mark the settings of valves, splitters, dampers, and other adjustment devices, so that adjustment can be restored if disturbed at any time. Set memory stops on balancing valves. Return and make required adjustments after submittal and approval of the Certified Balance Report.

END OF SECTION
SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Definitions and general requirements applicable to the insulation systems specified in "Related Sections."

1.2 RELATED SECTIONS

A. HVAC piping insulation: Section 23 07 19.

B. Duct insulation: Section 23 07 13.

C. HVAC equipment insulation: Section 23 07 16.

1.3 REFERENCES


B. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials

C. UL 723: Standard for Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Ceiling space: The space between the ceiling and the floor of an air-conditioned space above.

B. Roof space: The space between the ceiling and the roof, where building insulation is located at the roof level or the space between the ceiling and the floor of a non-air conditioned space above.

C. Attic space: The space between the ceiling and the roof, where building insulation is located at the ceiling level.

D. Air-conditioned areas or spaces: Areas or spaces where the occupied room temperature is maintained between 65 and 80 degrees F (18.3 and 26.7 degrees C).

E. Concealed insulation shall include work:
1. Above ceilings.
2. Where furred in and in pipe chases.

F. Exposed insulation shall include work:

1. In all rooms and areas.
2. In mechanical equipment rooms, penthouses, or other similar utility spaces.
3. In storage rooms.

G. Unconditioned areas: Areas outside of the insulated envelope.

H. Finished spaces: Areas of the building accessible to the public and to building occupants other than service personnel.

1.5 QUALITY ASSURANCE

A. Perform work in strict accordance with the building, fire and safety codes of the state, county or city in which the work is performed.

B. Insulation, including fittings and butt strips, jackets, facings, and accessories such as adhesives, mastics, cements, tapes, and cloth, shall have a fire and smoke hazard rating and label as tested by ASTM E84, NFPA 255, and UL 723, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50.

C. All insulation and accessories shall be free of asbestos.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation and accessory products in manufacturers’ wrapping or cartons, identified on the exterior and bearing labels showing conformance to flame and smoke rating requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to sections listed in “Related Sections.”

PART 3 - EXECUTION

Not Used.

END OF SECTION
SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct insulation as with the thickness and R-value indicated in the schedule at the end of this section.

1.2 RELATED SECTIONS

A. Painting: Division 09.

B. Definitions and general insulation requirement: Section 23 07 00.

C. Acoustical duct liner: Section 23 31 13.

1.3 REFERENCES

A. American Society of Testing and Materials


1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer’s name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS
A. Manufacturer’s instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installer qualifications: Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store rigid insulation products so as to protect them from breakage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article “Product Options” in Section 23 01 01.

B. Mineral fiber insulation:

1. CertainTeed Corporation
2. Johns Manville
3. Knauf Fiber Glass GmbH
4. Owens-Corning

C. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac

2.2 MINERAL FIBER INSULATION MATERIALS

A. Flexible mineral fiber insulation: ASTM C 553, Type I, nominal density at least 1 pound per cubic foot (16 kg per cubic meter), k-factor of 0.27 at 75 degrees F (k(SI) of 0.037 at 24 degrees C) mean temperature, of thickness as specified in Part 3 below, with foil-scrim-kraft vapor-barrier jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
1. Minimum R-value of R-4.5 (RSI-0.79) with 1.5 inches (38 mm) of thickness in the installed condition with 25% compression.
2. Minimum R-value of R-6 (RSI-1.06) with 2 inches (50 mm) of thickness in the installed condition with 25% compression.

B. Rigid mineral fiber insulation: ASTM C 612, Types IA-IB, nominal density at least 6 pounds per cubic foot (96 kg per cubic meter), with k-factor of 0.22 at 75 degrees F (k(SI) of 0.032 at 24 degrees C) mean temperature, of thickness as specified in Part 3 below, with factory-applied jacket composed of a reinforced white kraft and aluminum-foil laminate with the white kraft facing out. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

1. Minimum R-value of R-6.8 (RSI-0.79) with 1.5 inches (38 mm) of thickness.
2. Minimum R-value of R-9.1 (RSI-1.06) with 2 inches (50 mm) of thickness.

C. Mineral fiber insulation accessories

1. Mechanical fasteners: Adhesively attached, minimum 12-gauge zinc-plated steel pin welded to a 2 inch by 2 inch, 22 gauge minimum galvanized steel perforated baseplate and self-locking retaining washer. Pin length as required. Comply SMACNA HVAC Duct Construction for Mechanical Fasteners. Provide adhesive recommended by fastener manufacturer. Peel and press (self-sticking) type fasteners are not acceptable.
2. Tape for flexible mineral fiber insulation: Self-adhesive foil-scrim-kraft vapor-barrier tape with removable backing and pressure-sensitive acrylic adhesive, 3” (75 mm) wide minimum. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
3. Tape for rigid mineral fiber insulation: Self-adhesive foil faced vapor-barrier tape with removable backing and pressure-sensitive acrylic adhesive, 2” (50 mm) wide minimum. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
4. Mineral fiber insulation vapor barrier mastic:
   a. Vapor barrier coating for use over ASJ jackets to give a vapor barrier seal at joints, laps and punctures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
   b. Equal to Foster 30-65 “Vapor-Fas”.
5. Corner Angles: Aluminum, 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm).
6. Trapeze hanger support inserts: Calcium silicate insulation, ASTM C 533, Type I.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION
A. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer’s printed instructions.

B. Tape and seal terminations of insulation with vapor barrier mastic.

C. Provide continuous insulation and jacket through trapeze hanger supports. 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.

D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

E. 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.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with longitudinal seams at top and bottom of horizontal runs.

H. Install multiple layers of insulation with longitudinal and end seams staggered.

I. Install insulation with least number of joints practical.

J. Stagger joints.

K. Install insulation continuously around hangers.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

3.2 INSTALLATION INSIDE BUILDINGS

A. Install in accordance with the Minimum Insulation Thickness and R-Value Schedule at the end of this section.

B. Concealed ducts: Provide flexible mineral fiber insulation.
1. Mechanical fasteners: On ducts more than 24 inches (610 mm) wide, secure insulation on the underside with mechanical fasteners as required to prevent sagging, 16” (406 mm) maximum on center and 3” (75 mm) maximum from joints. Secure insulation in place with washers firmly embedded in insulation. Cut excess portion of pins extending beyond washers. Cover exposed pins and washers with tape.

2. Transverse joints and longitudinal seams: Butt insulation with facing overlapping at least 2 inches (50 mm). Staple and seal with tape.

3. Seal breaks and punctures with tape.

C. Exposed ducts: Provide rigid mineral fiber insulation.

1. Mechanical fasteners: Fastened with mechanical fasteners. Fasteners shall be spaced 16” (406 mm) on center with a minimum of two rows per side of duct and 3” (75 mm) maximum from joints. Secure insulation in place with washers firmly embedded in insulation. Cut excess portion of pins extending beyond washers. Cover exposed pins and washers with tape.

2. Transverse joints and longitudinal seams: Provide a continuous unbroken vapor barrier. Create a facing lap by removing 2 inches (50 mm) from one edge and one end of insulation segments. Secure laps to adjacent insulation section with staples, 6 inches (150 mm) on center maximum. Seal seams and joints with tape.

3. Seal breaks and punctures with tape.

4. Apply corner angles to all outside corners and straight edges.

5. For curved surfaces, such as exposed elbows, score or cut insulating board in narrow strips as necessary for snug and neat fit.

D. Ductwork which transmits air that may be either cooled or heated, or untempered air, shall be insulated as specified below for cooling systems.

E. Where necessary to conceal the standing seams and reinforcing angles on exposed ducts, increase insulation thickness to 2 inches (50 mm).

F. Casings and headers of reheat coils shall be insulated with the same thickness as adjacent ductwork.

G. Installation on dedicated outdoor air ductwork.

1. Conditioned outdoor air or supply air ducts from dedicated outdoor air systems shall be insulated as specified for supply air ducts for cooling systems.

2. Return or exhaust air ducts from dedicated outdoor air systems shall be insulated as specified for return air ducts for cooling systems.

3.3 SCHEDULES

(See schedule, next page)
<table>
<thead>
<tr>
<th>Location/Condition</th>
<th>Minimum Insulation Thickness</th>
<th>R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor air</td>
<td>1.5 inches (38 mm)</td>
<td>Default</td>
</tr>
<tr>
<td>Exhaust air from air-conditioned areas</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Exhaust air and pressure relief between exterior connection and ATC damper, but not less than 10 feet (3 meters)</td>
<td>1.5 inches (38 mm)</td>
<td>1.5 inches (38 mm) R-4.5 (RSI 0.79)</td>
</tr>
<tr>
<td>Cooling Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply air</td>
<td>1.5 inches (38 mm)</td>
<td>Default</td>
</tr>
<tr>
<td>Lined supply air</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Pre-insulated round or oval supply air</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Return air and transfer</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Lined return air and transfer</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Pre-insulated round or oval return air and transfer</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Heating Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply air</td>
<td>1.5 inches (38 mm)</td>
<td>Default</td>
</tr>
<tr>
<td>Lined supply air</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Pre-insulated round or oval supply air</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Return air and transfer</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Lined return air and transfer</td>
<td>Not required</td>
<td>Default</td>
</tr>
<tr>
<td>Pre-insulated round or oval return air and transfer</td>
<td>Not required</td>
<td>Default</td>
</tr>
</tbody>
</table>

Notes:
1: Default insulation thickness shall be increased to 2 inches (50 mm) where necessary to conceal standing seams and reinforcing angles on exposed ducts.
2: Insulation R-value added to the R-value of lined or pre-insulated duct exceeds R-6 (RSI 1.06)

END OF SECTION
SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment insulation as scheduled at end of section.

1.2 RELATED SECTIONS

A. Definitions and general insulation requirements: Section 23 07 00.

1.3 REFERENCES

A. American Society of Testing and Materials

1. Standards for mineral fiber insulation materials

b. ASTM C 612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer’s name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer’s instructions: Recommended accessory materials and products; installation instructions.
1.6 QUALITY ASSURANCE

A. Installer qualifications: Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store rigid insulation products so as to protect them from breakage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article “Product Options” in Section 23 01 01.

B. Mineral fiber insulation:
   1. CertainTeed Corporation.
   2. Johns Manville
   3. Knauf Fiber Glass GmbH
   4. Owens-Corning

C. Coatings, adhesives, and fabrics:
   1. Childers
   2. Foster
   3. Manville Building Materials Group
   4. Rock Wool Manufacturing Company
   5. Trimac

2.2 MINERAL FIBER INSULATION MATERIALS

A. Mineral fiber board insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB for use with temperatures up to 450 Degrees F (232 Degrees C), with factory-applied ASJ.

B. Mineral fiber tank insulation: Mineral or glass fibers bonded with a thermosetting resin, semi-rigid segmented insulation with jacket made to wrap around tanks. Comply with ASTM C 612, Type IA or Type IB for use with temperatures up to 450 Degrees F (232 Degrees C), with factory-applied ASJ.
C. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

D. Mineral fiber insulation adhesive:
   1. Solvent free, low VOC, water-based adhesive designed for bonding mineral fiber insulation to steel or aluminum surfaces, and compatible with service temperatures.
   2. Equal to Foster 85-60 “Quick-Tack”.

E. Mechanical fasteners: Adhesively attached, minimum 12-gauge zinc-plated steel pin welded to a 2 inch by 2 inch, 22 gauge minimum galvanized steel perforated baseplate and self-locking retaining washer. Pin length as required. Comply SMACNA HVAC Duct Construction for Mechanical Fasteners. Provide adhesive recommended by fastener manufacturer. Peel and press (self-sticking) type fasteners are not acceptable.

F. Mineral fiber tank insulation staples: Outward-clinching insulation staples, nominal 3/4-inch (19-mm) wide, stainless steel or Monel.

G. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, pressure sensitive, complying with ASTM C 1136; 3 inch (75 mm) width.

H. Insulating cement: Mineral fiber cement with a hydraulic-setting binder, conforming to ASTM C 449.

I. Corner Angles: Aluminum, 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide insulation in accordance with the Insulation Thickness and Material Schedule at the end of this section, as modified by specifications for each location and type.

B. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer’s printed instructions.

C. Insulate equipment as specified, except equipment with factory-applied insulation.

D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

E. 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.
F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with least number of joints practical.

H. Stagger joints.

I. Install insulation continuously around anchor attachments.

J. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

3.2 INSTALLING MINERAL FIBER INSULATION (HOT SURFACES)

A. Insulate equipment surface.

B. Do not insulate flanges, bolts, and accessories.

C. Do not insulate the following. Bevel and seal insulation edges:

1. Testing agency labels and stamps.
2. Manufacturer’s nameplates and data plates.
4. Hand holes.
5. Cleanouts.

D. Secure mineral fiber board insulation and mineral fiber tank insulation with adhesive and mechanical fasteners. Fasteners shall be spaced 16” (406 mm) on center with a minimum of two rows per side of equipment surface and 3” (75 mm) maximum from joints. Secure insulation in place with washers firmly embedded in insulation. Cut excess portion of pins extending beyond washers. Cover exposed pins and washers with ASJ tape.

E. Secure mineral fiber tank insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

F. Cut, score, or miter insulation to fit contour of equipment.

G. Fill voids with insulating cement.

H. Joints and seams: Provide a continuous jacket barrier. Create a facing lap by removing 2 inches (50 mm) from one edge and one end of insulation segments. Secure laps to adjacent insulation section with staples, 6 inches (150 mm) on center maximum. Seal seams and joints with tape.
I. Seal breaks and punctures with ASJ tape.

J. Apply corner angles to all outside corners and straight edges.

K. Finish insulation with two coats of lagging finish coating with glass cloth and tape embedded between coats. Overlap glass cloth seams a minimum of 2 inches (50 mm).

3.3 EQUIPMENT INSULATION SCHEDULE

A. Insulation thickness and material schedule:

<table>
<thead>
<tr>
<th>INSULATION THICKNESS AND MATERIAL SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
</tr>
<tr>
<td>Heating water air separators</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC piping insulation for the interior piping systems listed in the minimum insulation thickness schedule at the end of this section.

B. HVAC piping insulation for the exterior piping systems.

1.2 RELATED SECTIONS

A. Firestopping: Division 07.

B. Painting: Division 09.

C. Definitions and general insulation requirements: Section 23 07 00.

D. Pipe hangers and protection shields: Section 23 05 29.

1.3 REFERENCES

A. American Society of Testing and Materials

1. Standards for mineral fiber insulation materials

   b. ASTM C 547: Mineral Fiber Pipe Insulation.
   c. ASTM C 553: Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

2. Standards for flexible elastomeric insulation materials

   a. ASTM C 534: Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

3. Standards for all insulation materials

   a. ASTM C 450: Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.

4. Standards for field applied jackets and accessories
   c. ASTM B 209: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer’s name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer’s instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article “Product Options” in Section 23 01 01.

B. Mineral fiber insulation:
1. CertainTeed Corporation.
2. Johns Manville
3. Knauf Fiber Glass GmbH
4. Owens-Corning

C. Flexible elastomeric insulation:

1. Aeroflex USA *
2. Armacell LLC *
3. K-Flex USA
4. Rubatex

D. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac

2.2 MINERAL FIBER INSULATION MATERIALS

A. Mineral fiber preformed pipe insulation: Glass fibers bonded with a thermosetting resin, ASTM C 547 Type I, with factory-applied ASJ-SSL jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. ASJ-SSL jacket:

1. All service jacket with self-sealing lap
2. White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip
3. Complying with ASTM C 1136, Type I.

C. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, pressure sensitive, complying with ASTM C 1136; 3 inch (75 mm) width. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

D. Mineral fiber blanket insulation: Glass fibers bonded with a thermosetting resin, ASTM C 553, Type IV, without facing. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
E. Mineral fiber preformed fitting and valve covers: Glass fibers bonded with a thermosetting resin, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

F. Mineral fiber insulation adhesive:

1. Solvent free, low VOC, water-based adhesive designed for bonding mineral fiber insulation to steel or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Foster 85-60 “Quick-Tack”.

G. Mineral fiber insulation vapor barrier mastic:

1. Vapor barrier coating for use over ASJ jackets to give a vapor barrier seal at joints, laps and punctures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Foster 30-65 “Vapor-Fas”.

H. Insulating cement: Mineral fiber cement with a hydraulic-setting binder, conforming to ASTM C 449. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

2.3 FLEXIBLE ELASTOMERIC INSULATION MATERIALS

A. Flexible elastomeric preformed pipe insulation: Closed-cell, sponge- or expanded-rubber, ASTM C 534, Type I for tubular materials. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. Flexible elastomeric preformed fitting and valve covers: Closed-cell, sponge- or expanded-rubber, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

1. Where flexible elastomeric insulation is used on hot gas piping in VRF applications, provide, in addition to the requirements above, EPDM based elastomeric rated for continuous operation at 300 degrees F (149 degrees C), and meeting an ASTM E 84 surface burning characteristic (flame spread/smoke developed) rating less than 25/50 at 2 inches (50 mm) of thickness.
C. Flexible elastomeric insulation adhesive:

1. Water resistant contact cement designed especially suited for bonding two impermeable surfaces and recommended for rubber foam, steel, or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Foster 85-75 “Drion”.

D. Flexible Elastomeric Tape: Black, closed cell, self-adhering, elastomeric thermal insulation tape for insulating pipes and fittings, 0.125 inch (3 mm) thick, 2 inches (50 mm) wide, ASTM C 534, Type I — Grade 1. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

E. Flexible elastomeric insulation vapor barrier coating:

1. Water-based latex enamel coating for use over flexible elastomeric insulation, providing a moisture-resistant protective finish suitable for both indoor and outdoor applications. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Equal to Armacell “WB Armaflex” latex enamel.

2.4 FASTENERS

A. Aluminum bands: ASTM B 209, 0.75 inches (19 mm) wide and 0.020 inches (0.4 mm) thick.

2.5 FIELD-APPLIED JACKETS

A. Aluminum jacket:

1. Jacket material: Smooth aluminum, 0.016-inch (0.4 mm) thickness for Insulation of 24 inches (610 mm) outside diameter or less: 0.024 inch (0.6 mm) thickness for larger outside diameters, lined with a bonded moisture barrier, factory cut and rolled to size, conforming to ASTM C 1729.
2. Fitting covers: Manufacturer’s factory-fabricated fitting covers made from the same material, finish, and thickness as the jacket, suitable to the size of fittings and thickness of insulation. Provide factory fabricated fitting covers for elbows, tees, flanges, unions, reducers, end caps, valves, and other fittings. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Aluminum straps: Same alloy as jacket, conforming to ASTM B 209.

B. Polyvinyl chloride (PVC) jacket:
1. Jacket material: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

2. Color: White

3. Adhesive: As recommended by jacket material manufacturer. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

4. Fitting covers: Manufacturer’s factory-fabricated fitting covers made from the same material, finish, and thickness as the jacket, suitable to the size of fittings and thickness of insulation. Provide factory fabricated fitting covers for elbows, tees, flanges, unions, reducers, end caps, valves, and other fittings. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

5. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket and fitting covers with acrylic adhesive; suitable for indoor and outdoor applications, 2 inch (50 mm) width, 6 mil (0.15 mm) thickness. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

C. Canvas jacket:

1. Jacket material: 8 ounces per square yard (270 grams per square meter), fire-retardant treated.

2. Lagging adhesive:
   - Polyvinyl acetate water-based adhesive and coating used indoors to adhere and size canvas over pipe insulation, and able to be top coated with solvent-based paints. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
   - Equal to Foster 81-42W “Lagfas”.

3. Lagging finish coating:
   - Washable, abrasion-resistant, indoor insulation coating for canvas. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
   - Equal to Foster 30-36 “Sealfas”.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Fabric-reinforcing mesh:

1. Woven Glass-Fiber Fabric: Approximately 2 ounces per square yard (68 grams per square meter) for covering pipe and pipe fittings.
2.7 FIELD-APPLIED GLASS CLOTH

A. Glass cloth: Woven Glass-Fiber Fabric: MIL-C-20079H. Type I, plain weave, 8 ounces per square yard (270 grams per square meter).

B. Glass cloth tape: Type II, Class 3, 4.5 ounces per square yard (150 grams per square meter).

C. Lagging finish coating:
   1. Washable, abrasion-resistant, indoor insulation coating for glass lagging cloth. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
   2. Equal to Foster 30-36 “Sealfas”.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide interior piping insulation in accordance with the Minimum Insulation Thickness Schedule for Interior Application at the end of this section, as modified by specifications for each location and type.

B. Provide field applied jackets in accordance with the Field-Applied Jacket Schedule at the end of this section, as modified by specifications for each location and type.

C. Provide mineral fiber insulation unless otherwise indicated.

D. Provide flexible elastomeric insulation for refrigerant piping.

E. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer’s printed instructions.

F. Maintain a continuous vapor barrier on systems that convey fluid at below-ambient temperatures, including the following applications:
   1. Refrigerant piping

G. Where a continuous vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

H. Installation at pipe hangers:
   1. Insulation shall be continuous through hangers for all piping systems.
2. Install pipe covering protection shields with thickness of structural insulation inserts equal, under load, to that of adjoining insulation.

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.

5. Shields and structural insulation inserts are specified in Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment.

I. Where insulated piping systems pass through sleeves or openings in partitions and floors, the insulation shall be continuous through the sleeves and openings. See Firestopping specifications for coordinating insulation and firestopping.

J. Install insulation materials, accessories, and finisher with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

K. 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.

L. Install insulation with longitudinal seams at top and bottom of horizontal runs.

M. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

N. Install insulation with least number of joints practical.

O. Finish installation with systems at operating conditions. Repair separations and cracking caused by thermal movement.

P. Return piping systems shall be insulated to meet the temperature demands of supply piping systems. There shall be no reduction of insulation thickness for anticipated temperature change between supply and return.

3.2 INSTALLING MINERAL FIBER INSULATION

A. Install insulation with factory-applied jackets as follows:

1. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive.
2. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
3. Cover circumferential joints and longitudinal seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
4. Where a continuous vapor barrier is indicated, apply vapor-barrier mastic on longitudinal seams and circumferential joints and at ends adjacent to pipe flanges and fittings.
5. Repair damaged insulation jackets by applying same jacket material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere and seal patches.

B. 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 using mineral fiber preformed fitting and valve covers whenever possible. Install preformed fittings with adhesive. Coat with mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
3. Where mineral fiber preformed fitting and valve covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces 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. Coat with mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
4. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
5. Valves: Insulate up to and including the bonnets, stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
6. Strainers: Insulate so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.
7. Flanges and unions: Install preformed pipe insulation to outer diameter of flange or union. Make width of insulation section same as overall width of union or flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange or union insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation. Coat with vapor barrier coating and reinforcing mesh before applying fitting cover.

C. Installation of casings and headers of coils:

1. Provide mineral fiber insulation, same thickness as on adjacent piping, adhered to casings and headers.
2. Coat with mastic.
3. Finish with two coats of lagging finish coating with glass cloth and tape embedded between coats.

3.3 INSTALLING FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and circumferential joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Installation on fittings and flanges:

1. Install insulation over fittings and flanges with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate using flexible elastomeric preformed fitting covers whenever possible. Install preformed fittings with adhesive. Tape and seal with vapor barrier coating.
3. Where flexible elastomeric preformed fitting covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces and bonded with adhesive. Tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
4. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
5. Flanges: Install pre-formed pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. 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. Secure insulation to flanges and tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.

3.4 INSTALLING FIELD-APPLIED JACKETS

A. Installing PVC jacket:

1. Provide jacket tight to insulation.
2. Provide with 1-inch (25-mm) overlap at longitudinal seams and circumferential joints.
3. For horizontal applications, install with longitudinal seams along top and bottom of pipes.
4. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under the jacket lap and another finish bead along each seam and joint edge.
5. Seams and joints shall completely prevent the entrance of water.

B. Installing canvas jacket: Adhere canvas jacket with lagging adhesive. Finish with lagging finish coating, ready for painting.

3.5 INSTALLING EXTERIOR PIPING INSULATION

A. Locations: Provide insulation for piping systems exterior of building heated space, including but not limited to attics and unheated parking garages.

B. Insulation: Material as specified for interior systems unless otherwise indicated.

C. Start insulation 30 inches (760 mm) below grade, 30 inches (760 mm) below roof or 30 inches (760 mm) inside exterior wall. Secure insulation with aluminum bands on 12-inch (305-mm) centers.

D. Where required, install electric heat cable before applying insulation.

3.6 SCHEDULES

A. Minimum insulation thickness schedule for interior heating water applications:

<p>| MINIMUM INSULATION THICKNESS SCHEDULE FOR INTERIOR HEATING WATER PIPING APPLICATIONS (1) |
|-----------------------------------------------|--------------------------------------------------|--------------------------------------------------|</p>
<table>
<thead>
<tr>
<th>Fluid Temperature Range</th>
<th>NPS 1.25 (DN 32) &amp; Smaller (note 2)</th>
<th>NPS 1.5 (DN 40) &amp; Greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>105F to 200F (40C to 93C)</td>
<td>1.5-inch (38 mm)</td>
<td>2-inch (51 mm)</td>
</tr>
</tbody>
</table>

(1) - See additional thickness requirements for exterior applications.
(2) - Contractor’s option within partitions only: 1-inch (25 mm) flexible elastomeric insulation.

B. Minimum insulation thickness schedule for interior air conditioning refrigeration applications:

<p>| MINIMUM INSULATION THICKNESS SCHEDULE FOR INTERIOR AIR CONDITIONING REFRIGERATION APPLICATIONS (1) |
|-----------------------------------------------|---------------|---------------------|</p>
<table>
<thead>
<tr>
<th>Application</th>
<th>Fluid Temperature Range</th>
<th>NPS 1.25 (DN 32) &amp; Smaller</th>
<th>NPS 1.5 (DN 40) &amp; Greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerant Liquid (3)</td>
<td>61F to 104F (16.1C to 40C)</td>
<td>Not Required</td>
<td>Not Required</td>
</tr>
<tr>
<td>Refrigerant Suction</td>
<td>61F to 104F</td>
<td>0.5-inch</td>
<td>0.5-inch</td>
</tr>
</tbody>
</table>
### MINIMUM INSULATION THICKNESS SCHEDULE FOR INTERIOR AIR CONDITIONING REFRIGERATION APPLICATIONS (1)

<table>
<thead>
<tr>
<th>Application</th>
<th>Fluid Temperature Range</th>
<th>NPS 1.25 (DN 32) &amp; Smaller</th>
<th>NPS 1.5 (DN 40) &amp; Greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerant Hot Gas (2)</td>
<td>(16.1C to 40C)</td>
<td>(13 mm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>105F to 140F (40.6C to 60C)</td>
<td>1-inch (25 mm)</td>
<td>1.5-inch (38 mm)</td>
</tr>
</tbody>
</table>

(1) - See additional thickness requirements for exterior applications.
(2) – Hot gas may be required for split system hot gas reheat applications.
(3) – Insulate piping with 0.5-inch (13 mm) thick insulation where there is a possibility of contact with the piping by occupants other than service personnel.

### C. Field-applied jacket schedule:

<table>
<thead>
<tr>
<th>Application</th>
<th>PVC Jacket</th>
<th>Canvas Jacket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior applications</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pipe insulation exposed in mechanical rooms, penthouses, and other service areas not accessible to the public.</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 23 08 00 - SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

A. Upon completion of all systems startup, testing, adjusting, and balancing by the Contractors, the systems shall be commissioned in the presence of the Owner’s representative. The commissioning process shall include final testing and final adjustments.

B. The Contractors shall be responsible for coordinating the commissioning process to ensure that all necessary personnel including installers and manufacturer’s representatives are available on site to assist during the commissioning process. Personnel shall be available to make final adjustments to systems as directed, respond to questions regarding the operation of systems, demonstrate the systems, and train the Owner’s personnel to operate and maintain the systems.

C. The Contractors shall fully cooperate with the Owner during the commissioning process to include adjustments to air and water flow rates and adjustments to the operation of the environmental monitoring and control system to obtain the proper environmental conditions.

D. Provide additional time and services for commissioning which is required due to system or equipment deficiency.

1.2 DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. BoD: Basis of Design.

C. BoD-HVAC: HVAC systems basis of design.

D. CxA: Commissioning Authority.

E. OPR: Owner’s Project Requirements.

F. Substantial Completion: Defined in the Conditions of the Contract. When testing specified in ‘Testing’ in Part 3 below has begun and is proceeding successfully, the Contractor may begin the process to certify Substantial Completion. Commissioning shall be completed before final completion.
G. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean ‘as-built’ systems, subsystems, and equipment.

H. TAB: Testing, Adjusting, and Balancing.

1.3 CONTRACTOR’S RESPONSIBILITIES

A. Mechanical contractor:

1. Attend TAB verification testing.
2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

B. HVAC instrumentation and control subcontractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

C. TAB subcontractor:

1. Contract documents review: With the CxA, review the Contract Documents before developing TAB procedures.

   a. Verify the following:

   (1) Accessibility of equipment and components required for TAB work.
   (2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
   (3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
   (4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
   (5) Air and water flow rates have been specified and compared to central equipment output capacities.

D. Electrical contractor:

1. With the mechanical contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

1.4 COMMISSIONING DOCUMENTATION
A. Test checklists: CxA shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Standard checklists developed by organizations, such as AABC Commissioning Group, are acceptable, if items noted below are included. Checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences for HVAC systems.
4. Strength of control signal for each set point at specified conditions, as recorded by automatic temperature control subcontractor.
5. Responses to control signals at specified conditions.
6. Sequence of response(s) to control signals at specified conditions.
7. Electrical demand or power input at specified conditions.
9. Expected performance of systems, subsystems, and equipment at each step of test.
10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected result.
11. Interaction of auxiliary equipment.
12. Issues log.

1.5 SUBMITTALS

A. The following submittals are in addition to those specified in Division 01 Section ‘Submittal Procedures.’

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing, as specified in Division 01 and in ‘Prerequisites for testing’ in Part 3 below.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Subcontractor as specified in Division 23 Section ‘Testing, Adjusting, and Balancing.’
E. Certified Pipe Cleaning and Flushing Report: CxA shall certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.

F. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates required by the specifications, and shall include them in systems manual and commissioning report, whether witnessed by the CxA or not.

G. Corrective Action Documents: CxA shall submit corrective action documents.

H. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 - PRODUCTS

2.1 REPLACEMENTS

A. CxA will report any defective materials and equipment which become apparent during the commissioning process. The Contractor shall repair or replace defective materials and equipment with specified material and components. This work shall be accomplished at no addition to the Contract Sum.

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Contractor’s certification of readiness of systems or parts of the work for testing shall be as required in ‘Submittals’ in Part 1 above.

1. If CxA begins testing, and finds that the systems or equipment are not ready (false start), the additional cost to restart testing will be charged to the contractor or subcontractor who prepared the certificate of readiness, by the procedures provided in the Contract for changes in the work.

2. Evidence that a system or equipment is not ready: Ten percent of system or equipment is tested and fails to perform requirements.

B. Prerequisites for testing: Contractors and subcontractors shall:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.

2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded and labeled in the field.

3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

9. Annotate checklist or data sheet when a deficiency is observed.

10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

   a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
   b. Operation of terminal units in both heating and cooling cycles.
   c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
   d. Building pressurization.
   e. Total exhaust airflow and total outdoor-air intake.
   f. Operation of indoor-air-quality monitoring systems.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

   a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
   b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

C. The percentage of HVAC systems and equipment to be commissioned on this project include:

   1. Heating water systems: 100 percent
   2. Chilled water system: 100 percent
   3. Pumping systems: 100 percent
4. Rooftop air-handling units: 100 percent
5. Rooftop energy recovery units: 100 percent
6. Air-handling units: 100 percent
7. VAV air terminals: 35 percent
8. CAV, dual-duct air terminals: 35 percent
9. Fan-coil units: 35 percent
10. Unit ventilators: 35 percent
11. Ductless split systems: 20 percent
12. Packaged terminal air conditioners: 20 percent
13. Exhaust systems: 20 percent

D. The electrical systems to be commissioned on this project include:

1. Emergency generator (Function and power switchover)

E. Testing instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes include the following:

1. Occupied and unoccupied
2. Warm up and cool down
3. Economizer cycle
4. Emergency power supply
5. Life-safety and safety systems
6. Smoke control
7. Fire safety
8. Temporary upset of system operation
9. Partial occupancy conditions
10. Special cycles

3.2 TAB VERIFICATION

A. TAB subcontractor shall coordinate with CxA for work required in Division 23 Section ‘Testing, Adjusting, and Balancing.’ TAB subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. HVAC contractor and CxA shall witness TAB work.

C. TAB preparation:

1. TAB subcontractor shall provide CxA with data required for ‘Pre-Field TAB Engineering Reports’.
a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Ductwork air leakage testing:

1. The HVAC contractor shall supply a copy of the ductwork air leakage testing report, witnessed by TAB subcontractor, as required in Section 23 31 13, to the CxA.
2. On approval of ductwork air leakage testing report, the CxA shall coordinate verification testing of ductwork air leakage testing. Verification testing shall include random retests of portions of duct section tests, reported in original ductwork air leakage testing report. The HVAC contractor shall perform tests using the same instrumentation (by model and serial number) as for original testing; the CxA shall witness verification testing.

E. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.
2. CxA shall notify TAB subcontractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item is defined as follows:
   a. For all readings other than sound, a deviation of more than 10 percent.
4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

F. If deficiencies are identified during verification testing, CxA shall notify the HVAC contractor and Engineer, and shall take action to remedy the deficiency. Engineer shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

G. CxA shall certify that TAB work has been successfully completed.

3.3 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

1. Contractor shall ensure that each system is ready for testing when tests are schedule, that is, plugged or capped for pressure and leak tests, and similar preparations.

B. Perform tests using design conditions whenever possible.
1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.

3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of HVAC Contractor testing:

1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.

2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Detailed testing procedures: CxA, with HVAC contractor, TAB subcontractor, and HVAC instrumentation and control subcontractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

E. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. CxA shall review and comment on submittals, test data, inspector record, and boiler certification and shall compile information for inclusion in systems manual.

F. HVAC instrumentation and control system testing:

1. Field testing plans and testing requirements are specified in Division 23 Controls Section. The CxA, HVAC contractor, and the HVAC instrumentation and control subcontractor shall collaborate to prepare testing plans.

2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

3. Testing shall include both the system at the project site and the related functions of the Owner’s operations center.

G. Pipe cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC contractor shall prepare pipe system cleaning, flushing, and hydrostatic testing. CxA shall review and comment on plan and final reports. CxA shall certify that pipe cleaning, flushing, hydrostatic tests, and chemical treatment have been completed. Plan shall include the following:
1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.


4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

H. Refrigeration system testing: HVAC contractor shall prepare a testing plan to verify performance of chillers, refrigerant compressors and condensers, and other refrigeration systems. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

I. HVAC distribution system testing: HVAC contractor shall prepare a testing plan to verify performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

J. Deferred testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.
K. Testing reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller’s sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
3. Prepare a preliminary test report. Deficiencies will be evaluated by Engineer to determine corrective action. Deficiencies shall be corrected and test repeated.
4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION
SECTION 23 09 01 - AUTOMATIC TEMPERATURE CONTROL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Complete new temperature control (ATC) system.

B. Sequence of operation for automatically controlled equipment is shown on drawings. ATC subcontractor shall cooperate with the unit suppliers and provide all relays and wiring required to integrate the sequence of operation.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Automatic control valves, pressure and flow switches, and insertion wells in piping: For installation under Section 23 21 13.

B. Dampers: For installation under Section 23 31 13.

C. Controls for air terminals specified in Section 23 36 00, including damper operator, terminal controller, and velocity controller, each complete with all appurtenances.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Wall thermostats for air terminal units: Section 23 36 00.

1.4 RELATED SECTIONS

A. Controls: Sections 23 09 01 through 23 09 23.

B. Balancing: Section 23 05 93.

1.5 SYSTEM DESCRIPTION

A. Provide a complete system of direct digital temperature controls with electronic and/or electric actuation.

1.6 DESIGN REQUIREMENTS

A. The products specified, scheduled, and shown on drawings are the basis of the design of this project.
B. For requirements affecting use of optional manufacturers, or substitutions, see Division 01 and Section 23 01 01, HVAC General Provisions, and Section 23 05 00, Common Work Results for HVAC.

1.7 SUBMITTALS

A. Contractor qualifications: Submit a list of a minimum of three projects similar to this project in type, size, and duty, which has been operating satisfactorily for not less than five years.

1. Include project name, address, name and phone number of Owner’s representative and project size and type.

B. Shop drawings: Provide a point schedule and composite control diagram of all equipment provided for each control sequence, including factory and field controls. Include a written description of sequences, in which each control device or item of equipment is identified by the designation indicated on the diagram.

C. Product data: See individual controls sections.

D. Certifications:

1. Factory authorization and certification of the installing company.
2. Evidence of training and certification of each supervisor and mechanic assigned to this project.

E. Project record documents: As specified in Division 01 and Section 23 0101, provide a drawing at the same scale as the contract drawings, showing the locations of all components installed.

1.8 QUALITY ASSURANCE

A. Subcontractor qualifications: One hundred percent company-owned, full-service, local branch or authorized factory-direct contractor for one of the acceptable national temperature control manufacturing companies named below, as follows:

1. Full service: Includes system engineering, shop drawing preparation, software programming, installation, commissioning, and service.
2. Factory-direct contractor: Is contracted directly with manufacturer to buy components and has direct access to manufacturer’s local branch office for engineering, service, and technical support without any third-party involvement.
3. Experience: The branch or factory-direct contractor shall have completed at least three system installations of the same type, size, and design, which have successfully operated their sequence of operations for at least three years.
4. Supervisors and mechanics: Factory-trained and certified in the type of control system (pneumatic, electric, digital, electronic) being installed, and directly employed by the subcontractor.

   a. The programmer responsible for programming digital controllers shall have a minimum of three years’ experience programming digital controllers of the manufacturer, for HVAC systems.

B. Qualified subcontractor shall prepare control diagrams.

C. Perform work in accordance with the plumbing, electrical, building, fire and safety codes of the state, county, or city in which the work is performed.

D. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Electric, electronic, or direct digital system:

   1. Honeywell, Inc.
   2. Johnson Controls, Inc.
   3. Invensys

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Coordinate with equipment suppliers to integrate controls provided by manufacturers into the control sequences shown on drawings.

B. Mount devices and control panels provided by equipment manufacturers, and provide required control wiring.

C. Operate, test, calibrate, and adjust each control system until it operates as intended by the manufacturer and as specified in the control sequence.

3.2 TESTS

A. Thoroughly test and check the completed system to ascertain that all equipment is functioning as intended and that dampers and valves respond properly to their controls.
Installer of work of this section shall cooperate with the equipment suppliers, and with balancing and testing work, to make necessary adjustments to ATC devices for proper operation of the completed system.

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

B. Provide at least eight hours of additional instruction time for the system specified in this section, consisting of two periods of 4 consecutive hours, separated by at least 30 days.

END OF SECTION
SECTION 23 09 02 - CONTROL SYSTEMS WIRING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wiring for automatic temperature control system.

1.2 RELATED SECTIONS

A. Automatic temperature control system: Sections 23 09 01 through 23 09 23.

B. Control sequences: Shown on drawings.

1.3 SUBMITTALS

A. Product data: Wire, cable, conduit and fittings, disconnecting switches, and transformers.

1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

B. Control system power circuits shall not supply power to other building components such as lights or receptacles.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Electrical materials and devices shall be UL listed and shall meet the requirements of NEC (NFPA 70) and Division 26, Electrical.

2.2 WIRING

A. Wiring 50 V and below: Fully color coded, copper 600 V type THW or THHN, minimum No. 22 or as specified in Division 26, Electrical.

B. Wiring above 50 V: As specified in Section 26 0519, Wires and Cables.

2.3 CONDUIT AND FITTINGS

A. Galvanized steel conduit: Minimum size 0.5 inches (16 mm), hot-dip galvanized with threads galvanized after cutting, one of the following:
1. Rigid full weight, heavy-wall steel conduit (RGS) conforming to UL 6 and ANSI C80.01.
2. Intermediate steel conduit (IMC) conforming to UL 1242 and ANSI C80.03.

B. Steel conduit fittings: Cast malleable iron fittings with smooth finish and full threaded hubs. Include steel or malleable iron locknuts, bushings, and other fittings.

1. Insulating bushings: Equal to Thomas & Betts Series 22.
2. Hub fittings with recessed sealing ring and nylon insulated throat equal to Thomas & Betts Series 370.
3. Fittings for exposed locations: Conduit outlet bodies, zinc or cadmium-plated.

C. Electrical metallic tubing (EMT):

1. Minimum size 0.5 inch (16 mm), maximum 1.5 inch (41 mm), hot-dip galvanized or sherardized thin-wall steel conduit conforming to UL 797 and ANSI C80.03.
2. Connectors and couplings for EMT: Concrete- or rain-tight, compression or set screw type, made of cadmium-plated steel with nylon insulating throat, equal to Thomas & Betts Series 5031, 5123 and 5120.

D. Flexible metal conduit:

1. Minimum size 0.5 inch (16 mm), made of sheet metal strip, interlocked construction, conforming to UL 1.
2. Connectors for flexible metal conduit: Equal to angle wedge “Tite-Bite” with nylon insulated throat, Thomas & Betts Series 3110 and 3150.

E. Liquidtight flexible metal conduit:

1. Conform to UL 360.
2. Liquidtight connectors: UL 14814A, with fittings and nylon-insulated throat, equal to Thomas & Betts Series 5331.

F. Surface metal raceway: Equal to Wiremold No. 700 minimum size, complete with fittings, connectors, and accessories.

G. Plastic conduit:

1. Polyvinyl chloride (PVC) Schedule 40, rated for use with 90-degree conductors, for exposed, underground, and encased applications, complying with NEMA Specification TC-2 and UL 651.
2. Plastic conduit fittings and cement:
   a. Fittings: Complying with NEMA TC 3 and UL 514.
b. Cement: Solvent cement made by the manufacturer of the conduit and fittings.

2.4 EQUIPMENT

A. Control transformer: Designed for power sources for 24-V ac control circuits, and precision built to ensure rated power, proper voltage regulation and maximum efficiency. Units shall be equipped with integral manual reset circuit breaker for over-current protection on the secondary winding. Output regulation shall be 10 percent from no load to full load.

B. Disconnecting switches: Specified in Section 26 28 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Electrical equipment is specified in Division 26, Electrical. Include in the work of this section relays, pushbuttons, transformers, coils, power wiring, control wiring, or other equipment, meeting requirements of Division 26, so that the automatic temperature control system will function as specified and indicated on the drawings.

B. Control system power source:

1. Terminal equipment:
   a. Applications include VAV terminal units, fan coil units, unit heaters, unit ventilators, and other similar space conditioning equipment dedicated to conditioning a single space.
   b. Terminal equipment power may be used to power associated terminal equipment controllers with the following additional requirements.
      (1) Provide power for the controller upstream of the terminal unit disconnect switch, allowing the controller to remain energized power to the equipment is disconnected.
      (2) Provide a fused disconnect between the power source and the controller.
   c. Where these conditions cannot be met, provide circuit breakers in panelboards and power circuits to power terminal equipment controllers.
   d. Where terminal equipment does not have a power connection, provide circuit breakers in panelboards and power circuits to power terminal equipment controllers.

2. Equipment control applications other than terminal equipment:
a. Applications include, but are not limited to, air handling equipment, large centralized exhaust systems, pumps, central plant equipment, and other non-terminal type equipment and systems.
b. Do not use equipment power as a source for control system power. Controllers shall remain energized when the power circuit to the equipment is deenergized.
c. Provide circuit breakers in panelboards and power circuits to power controllers.
d. Provide switches at each control panel to serve as disconnects; a panel may consist of multiple controllers within a single enclosure. Each panel shall be fused together.
e. Provide metal-oxide varistors to protect controllers.

3. Servers, switches, and other central control system components:
   a. Provide circuit breakers in panelboards and power circuits to power central control system components.
   b. Provide UPS and surge protection.

4. Provide circuit breakers that match and are compatible with other breakers in a panelboard.
5. Provide optional standby power for controls that support equipment provided with optional standby power.

C. Conduit
   1. Install conduit and wiring as specified in Sections 26 05 19 and 26 05 33.
   2. Where necessary to connect conduit to motors or motor-driven equipment, or to attach conduit to fan housings or air-handling units which contain fans, use a 24-inch (610-mm) looped section of flexible metallic conduit.

D. Provide data systems, including outlets, cabling, and required infrastructure, to support the manufacturers' requirements.

E. Make each run of cable or conductor connecting two points with a single continuous piece of cable or conductor. Do not splice. Cable or conductor may be extended by use of suitable connectors if approved by the Architect.

F. Shielding:
   1. All input, output, and communications wire is to be shielded except when specifically disallowed by the controller or end device manufacturer.
   2. All shields on controller input and output wiring shall be terminated except when specifically disallowed by the controller or end device manufacturer. The shield must be terminated at the controller end only.
   3. RS-485 communication shield wiring shall be continuous from one end of the trunk to the other and must only be terminated at the ‘originating’ router.
4. The shields (foil and drain wire) from individual wire segments at a controller must be twisted, and the free end of the shield taped back (using electrical tape) to one of the communication wires. A portion of the shield must be exposed to allow a technician to verify the continuity of the shield.

G. When connecting to electrical wiring of equipment provided with pilot lights, connect to circuit so that pilot light is energized only when equipment is energized.

H. When connecting to electric wiring of fans with Hand/Off/Automatic (HOA) switches and isolation dampers, connect to circuit so that isolation dampers open in both Hand and Automatic positions.

I. Securely attach disconnecting switches and starters to the wall with anchors.

END OF SECTION
SECTION 23 09 07 - CONTROL DAMPERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dampers for automatic control.

1.2 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION;

A. Dampers: Install under Section 23 31 13.

1.3 RELATED SECTIONS

A. Ductwork: Section 23 31 13.

B. Control system, general: Section 23 09 01.

C. Control sequences: Shown on drawings.

1.4 SUBMITTALS

A. Product data, including test data and ratings, for each type of damper and operator included in the work.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS AND OPERATORS

A. Supply and return dampers: Equal to Ruskin Model CD35. Dampers for two-position control may be parallel blade type. Dampers for modulating control shall be balanced, multi-louver, opposed-blade type.


2. Frames: Dampers shall be mounted horizontally in a welded channel angle or flat steel frame filled with solid air-stops which shall prevent air leakage between frame and blades. Provide corner braces on frames that measure more than 24 by 24 inches (610 by 610 mm). Finish: two coats of black enamel.

3. Operation: Provide blades with brass pivots operating in non-stick, corrosion-resistant bearings securely mounted in damper frames. Hardware and operating linkage shall be brass or cadmium plated steel. Linkage shall be adjustable in length; joints shall be pin and clevis or ball and socket, free of excessive play. Dampers shall
be capable of being positioned accurately from 100 percent open to 100 percent closed and of maintaining any given position indefinitely. Dampers requiring 100 percent closure shall have neoprene gasketed edges.

B. Outdoor air (OA), and exhaust air (EA) dampers: Equal to Ruskin CD 50 low-leakage damper, AMCA-rated Class 1 in accordance with AMCA 511, leakage no more than 4 cfm per square foot at 1-inch wg when tested in accordance with AMCA 500D.

1. Blades: Interlocking, minimum 0.125-inch (3.2-mm) thick extruded aluminum, airfoil shape, maximum width 6 inches.
   a. Dampers for two-position control: May be parallel blade type.
   b. Dampers for modulating control: Opposed-blade type.

2. Frames: Minimum 0.125-inch (3.2-mm) thick extruded aluminum, with provisions for mounting.

3. Edge seals: Inflatable, replaceable, double-edge blade seal, mechanically held. Flexible metal frame seal.

4. Operation: Linkage out of airstream. Axles 0.5-inch (13-mm) diameter and hexagonal, molded synthetic bearings.

C. Electric damper operators:

1. Electric motor type, suitable for ambient conditions of operation, with internal overload protection.

2. Stroke time: Select to be compatible with equipment and system operation, 30 seconds maximum.

3. Smoke control system actuators shall comply with governing code and NFPA requirements.

4. Power: 50 percent more than the minimum required to operate the associated damper.

5. Failsafe: Internal spring return shall drive damper to a failsafe position on loss of power unless indicated otherwise, generally outside air and exhaust air dampers shall close and return air dampers shall open, dampers serving emergency generators and other emergency equipment shall have a failsafe position to allow the equipment to operate.

6. Field adjustment: Actuators shall be field selectable to fail open or fail closed without actuator replacement, actuators shall be adjustable to any fixed position within its range when the actuator is not powered.

7. Modulating actuators shall be capable of stopping at all points across full range, and starting in either direction from any point in range.

8. Position feedback: Where indicated, equip two-position actuators with limit switches for remote monitoring of position, where indicated, equip modulating actuators to provide a position feedback control signal for remote monitoring, provide a position.
indicator and graduated scale on each actuator indicating open and closed travel limits.

9. Damper attachment: Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish dampers to be set in place under Section 23 31 13, Metal Ducts, under the supervision of the control subcontractor.

B. Install operators on control dampers. Operation of particular dampers in conjunction with operation of air-handling equipment is described in control sequences.

C. Set screws shall be set on a flat space on a round shaft. Provide a double set screw as a lock.

END OF SECTION
SECTION 23 09 08 - CONTROL VALVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Automatic control valves, actuators, and accessories.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Control valves: Section 23 21 13.

1.3 RELATED SECTIONS

A. Control system, general: Section 23 09 01.

B. Control sequences: Shown on drawings.

1.4 SUBMITTALS

A. Product data: Valves, devices, and actuators, each type included in project.

PART 2 - PRODUCTS

2.1 CONTROL VALVES

A. Two-way and three-way valves shall be sized by the control subcontractor and guaranteed to be of sufficient size to meet the heating or cooling requirements.

B. With no electric power on the valve actuator, valve shall be in the normal position determined by the application.

1. Unless indicated otherwise, heating system valves are normally open to allow full flow to coils.

2. Cooling valves are normally closed to stop all flow to coils.

C. Valves NPS 2 (DN 50) and smaller: Single-seated globe or union globe type with an equal percentage flow characteristic valve plug, capable of handling water at a maximum 150 psig (1035 kPa), 281 degrees F (138 degrees C). Valves shall have threaded ends.

1. Bodies: Cast brass, rated at 150 psig (1035 kPa).

2. Trim: Brass.
3. Stem: Stainless steel, with replaceable composition disk seat. The stem packing shall be synthetic elastomer U-copper type, utilizing the system pressure to prevent packing leaks.

D. Three-way valve: Mixing or diverting for modulating or two-position control of the direct-or reverse-acting type with maximum operating temperature of 250 degrees F (121 degrees C).

1. Bodies: Brass or bronze, rated at 150 psi (1034 kPa), with threaded end connections.
2. Trim: Bronze or brass.
3. Stem: Stainless steel with replaceable bronze or brass seat. The stem packing shall be silicone U-copper Teflon V ring.

E. Maximum pressure drop across water valves shall be 4.0 psi (28 kPa).

2.2 ELECTRIC VALVE OPERATORS

A. Low or line voltage electric or electronic motor type with minimum opening and closing time of 15 seconds, sized to provide sufficient power to operate the valve, and for full shutoff against the operating pressure.

B. Solenoid valves (quick-closing) are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLING VALVES

A. Install valves complete with operators, as indicated on drawings and as required by control sequences.
SECTION 23 09 13 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Control devices and accessories.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Wells: Section 23 21 13.

B. Differential pressure sensors: Section 23 21 13.

C. Provide controllers and damper actuators to manufacturer of terminal units specified in Section 23 36 00, for factory installation.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Duct-mounted smoke detectors: Section 28 31 00.

1.4 RELATED SECTIONS

A. Automatic temperature control system: Sections 23 09 01 through 23 09 23.

B. Sequence of operations: Shown on drawings.

1.5 SUBMITTALS

A. Shop drawings:

1. Each control device labeled with setting or adjustable range of control.
2. Wiring diagrams. Differentiate between factory-installed and field-installed wiring.

B. Product data:

1. For each device, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes, and installation instructions.
2. Each type of accessory. Include finishes.

C. Maintenance data: As required in Section 23 01 01, HVAC General Provisions.

1.6 MAINTENANCE
A. Provide two sets of manufacturer’s special tools for operating tamperproof fasteners, marked to identify their use.

B. Calibration kit for carbon dioxide sensors: Portable, for field calibration, including nitrogen gas, tubing, regulator, and case, with manufacturer’s instructions for performing calibration.

C. Deliver maintenance products to Owner’s designated storage area and store as directed.

D. Maintenance service: On Substantial Completion and building occupancy, calibrate carbon dioxide sensors and instruct Owner’s personnel in the procedure.

PART 2 - PRODUCTS

2.1 CONTROL DEVICES, GENERAL

A. Instruments with predetermined temperature or pressure setpoints shall be provided with a means of adjustment over a reasonable range. Adjustable devices for control of temperatures shall be graduated and calibrated in degrees F. Markings such as WARMER and COOLER are not acceptable.

B. Operating thermostats shall have a low point setting of 45 degrees F.

C. Devices mounted outdoors shall be weathertight construction or mounted in weathertight enclosure or inside weathertight units.

2.2 DIGITAL CONTROLS (ELECTRONIC)

A. Each room temperature sensor shall include a setpoint adjustment dial, a temperature indicator, an override switch, and a terminal jack.

1. The setpoint adjustment dial shall allow for modification of the temperature by the occupant. Setpoint adjustment may be locked out, overridden or limited as to time or temperature through software by an authorized operator.

2. The temperature indicator shall be a digital readout and shall be visible without removing the sensor cover.

3. The override switch shall initiate override of the night setback mode to normal (day) operation when activated by the occupant. The override function may be locked out, overridden or limited as to the time through software by an authorized operator.

4. The terminal jack shall be used to connect a portable operator’s terminal to control and monitor all hardware and software points associated with the controller.

5. Provide controller to accommodate sensor type. Provide room temperature sensors closely matched to the requirements of the associated controllers. Signal input and output shall be accurate, responsive, and silent. The sensor may be either RTD or thermistor type providing the following minimum performance requirements are met:
a. Accuracy: plus or minus 1 degree F (0.6 degrees C)
b. Operating range: 35 to 115 degrees F (2 to 46 degrees C)
c. Set point adjustment range: 55 to 95 degrees F (2 to 30 degrees C)
d. Calibration adjustments: None required
e. Installation: Up to 100 feet from controller
f. Set point modes: Independent Heating, Cooling, Night Setback-Heating, Night Setback-Cooling

B. Humidity sensors: Range shall be 10 to 90 percent RH with ±2 percent RH accuracy; wall mounted or insertion type as required by the installation.

C. Static pressure sensors:

1. Duct static pressure sensors shall be of the solid-state diaphragm type with integral 2-wire, 4-20 mA signal conditioning and high and low adjustments. Range shall be 0-5 inches wg; output shall be 4-20 mA. Accuracy shall be 0.025 percent per degree C maximum over a temperature sensitivity range of 25 to 75 degrees C.

D. Differential pressure sensing in piping: Differential pressure sensor and transmitter with pipe connections for extended pressure sensing elements, for control of variable frequency drives on pumping systems shall be of the solid-state type with NEMA 250 Type 4X cast aluminum and stainless steel housing. Provide with bleed screws to remove air in the line, stainless steel wetted parts, screw terminals for wiring connections, and three valve manifold. Zero and span adjustments shall be accessible externally. Output signal shall be 4-20 mA with response time of 30 to 50 ms and capable of operation against 1,000 ohm load.

1. Repeatability: Plus or minus 0.25 percent of full scale.
2. Range: Approximately 2 times device set point, suitable for application with pressure limit beyond expected fluid pressure during operation. Able to withstand surge pressures possible to be produced by system pumps.
3. Operating conditions: 0 to 175 degrees F (minus 18 to 79 degrees C), temperature compensated operation between 30 and 150 degrees F (minus 1 to 66 degrees C).

E. Sensors installed in pipes shall be installed in thermometer wells of bronze or stainless-steel materials. Heat transfer compounds shall be compatible with the sensor. Compression type fittings between sensors and thermometer wells are not acceptable.

F. Temperature sensors for air systems shall be RTD type. Sensors shall have a time constant response of less than 3 seconds to a temperature change of 1 degree. Sensors shall be coupled with industrial grade adjustable span transmitters to achieve the following range with the accuracy specified: 10 to 100 degrees F, plus or minus 1 degree F. Sensors shall be suitable for insertion into air ducts and have a minimum insertion of 6 inches.
2.3 AUXILIARY CONTROLS

A. Emergency fan disconnecting switch:

1. Switch: Surface-mounted emergency switch, red with molded, raised-letter identification.
   a. Octagonal pushbutton marked PUSH.
   b. Reset: Turn button.
   c. False alarm protector: Tamperproof clear polycarbonate shield in a frame that fits over the emergency switch. When the shield is lifted to gain access, a warning horn shall sound. Include 9-V dc battery.

2. Operation: Deenergizes the air-handling unit when pushed.
3. Instructions: Emergency sign, operating instructions, and laminated plastic nameplate, white letters on black background, text shown on drawings.

2.4 ACCESSORIES

A. Guards for wall-mounted thermostats, sensors, or other control devices: Size selected to suit device to be protected, designed for vertical or horizontal mounting.

1. For locations in finished spaces: Equal to Kele TG500 Series, double-wall cover, steel with manufacturer’s standard white enamel finish, with wall plate, base, lock, and two keys.
2. For locations in utility spaces: Equal to Kele AT1104, cast aluminum with openings on front and all sides, designed for mounting directly to wall.
3. Fasteners: Tamperproof. Include 2 sets of special tools as required in Part 1 above.

B. Plastic nameplates: As specified in Section 23 05 00, Common Work Results for HVAC, minimum plate size 0.75 by 2.5 inches, minimum letter size 0.1875 inch, properly identifying equipment and use.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Where averaging type bulbs or tubing and low temperature protection thermostats are installed within ductwork or unit casings, provide a removable galvanized frame with 1-inch square mesh wire for attaching the tubing in desired pattern. Where capillary passes through duct side or unit casing, provide split flange fitting to seal hole and protect the capillary in the duct or casing.
B. Instruments mounted on insulated ducts or equipment shall have mounting brackets arranged to permit full insulation on the duct.

C. Room thermostats or temperature sensors mounted in unit casing or on sampling chamber shall not be an acceptable substitute for insertion thermostats.

D. One-pipe transmitters may be used in insertion and immersion thermostat applications only as a sensing element for a receiver-controller.

E. Bulbs for outdoor air thermostats or temperature sensors shall be shielded from the sun and reflected heat rays. These bulbs may be located behind weather louvers of OA intakes but ahead of any ATC damper.

F. Special-purpose instruments, such as night thermostats, time clocks, timer switches, emergency thermostats, other appurtenances, and thermostats or sensors where two or more are mounted side by side, shall be provided with engraved nameplates which properly identify the items. Nameplates shall be mounted with vandalproof screws on the wall immediately below the item.

G. Temperature sensors and humidity sensors; Mount on wall, securely anchored. Mounting height from floor to top of device shall be 48 inches, as required for accessibility to persons using wheelchairs.

H. Mount wall-mounted devices with tamperproof screws. Where devices are located in new locations, use wall boxes securely anchored flush into the wall. Use copper tubing from ceiling to device either fished through wall cavity or chased into wall and patched to match existing surface. Use Wiremold to run around ceiling for inaccessible ceilings or conceal above accessible ceiling.

I. Provide guards for all wall-mounted devices, including thermostats, temperature sensors, humidity sensors, and carbon dioxide sensors.

   1. Mount guard base to wall by at least four tamperproof screws, entirely independent of device wall plate and cover.

J. Provide insulated base plates for wall-mounted devices, including thermostats, temperature sensors, humidity sensors, and carbon dioxide sensors, where mounted on exterior wall.

K. Provide manual override on temperature sensors as noted in sequence of operation.

L. Emergency fan disconnect switch: Install in location approved by Fire Marshal.

M. Differential pressure sensing in piping:
1. Install sensors/transmitter in an accessible location for inspection and replacement.
2. Install metallic tubing from sensor/transmitter to pressure sensing locations in piping.
3. Install isolation valves in process tubing as close to system connection as practical.
4. Install dirt leg and drain valve at each transmitter connection.

3.2 INSTALLING DIGITAL CONTROLLER

A. Provide wiring required between digital controller and equipment as scheduled on the
   Control Point Schedule.

B. Cooperate with Owner to set up the digital controller to operate as shown in sequence of
   operations on the drawings.

3.3 ADJUSTING

A. Calibrate carbon dioxide sensors: Perform zero and span calibrations, following
   manufacturer’s recommended procedures.

3.4 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

END OF SECTION
SECTION 23 09 23 - DIRECT DIGITAL BUILDING SYSTEMS CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Direct digital building control (DDC) system.
B. Network communications.
C. DDC panels.
D. System software.
E. Application-specific controllers.
F. Operator I/O devices.

1.2 RELATED SECTIONS

A. Coordination, installer qualifications, and acceptable manufacturers: Section 23 09 01.
B. Automatic temperature control system: Sections 23 09 01 through 23 09 23.
C. Control sequences: Shown on drawings.

1.3 SUBMITTALS

A. Installer qualifications: Submit as required in Section 23 09 01, Automatic Temperature Control System. Include, in addition to other requirements, the location of the support facility from which warranty and service will be provided, and a list of the names, titles, and training of the individuals who will be responsible for the work of this project.

B. Documentation: Submit complete documentation for the system hardware and software, including user’s manuals and other support sufficient to enable Owner’s personnel to understand and correctly operate the system. Include this documentation in Operation and Maintenance submittals in accordance with Division 01 and Section 23 01 01.

C. Certifications:

1. Data sheet or copy of government approval form showing that the system complies with FCC Regulations, Part 15, Section 15.
2. Results of functional and diagnostic field tests and calibrations, specified in Part 3. Submit copies of the installing technician’s checklist showing that the system has been completely set up and is ready to operate.

3. Submit Compliance Inspection Checklist, initialed and dated, showing satisfactory completion of the installation tests specified in Part 3.

1.4 WARRANTY AND SERVICE

A. General requirements: Provide all services, materials and equipment necessary for the successful operation and maintenance of the entire DDC system for the period of the general project correction period required by General Conditions, Division 01, and Section 23 0101. Provide parts, software, and labor required for the work. Schedule maintenance and adjustments to minimize effects on facility operations.

B. The adjustment and repair of the system includes computer equipment, software updates, transmission equipment, and sensors and control devices. Provide the manufacturer’s required adjustments and other work necessary to maintain system operation.

C. Personnel: Provide qualified personnel to accomplish work promptly and satisfactorily. Notify Owner in writing of the name of the designated service representative, and of changes in personnel.

D. Schedule of work: Schedule major inspections in June and December and minor inspections in March and September. Minor inspections shall include visual checks and operational tests of each item of equipment. Major inspections shall include all work described for minor inspections and the following work:

1. Clean equipment, including interior and exterior surfaces.
2. Perform signal, voltage, and system isolation checks of system workstations and peripherals.
3. Check and calibrate each field device. Check all analog points and digital points.
4. Run diagnostics and correct diagnosed problems.
5. Resolve and correct other observable problems.

E. Emergency service: Qualified personnel shall be available to provide service to the complete system. Furnish owner with a telephone number where service representative can be reached at all times. Service personnel shall be at the site within 8 hours after receiving a request for service, and shall restore the control system to proper operating condition within 24 hours.

F. Operation: Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the initial performance test.

G. System modifications: Make recommendations for system modification in writing to Owner. Do not make any system modifications, including operating parameters and
control settings, without prior written approval of Owner. Modifications to the system shall be incorporated into the operations and maintenance manuals and other documentation.

H. Software: During the project correction period, provide all software updates and verify operation in the system in a timely manner. Instruct the system operators, and incorporate updates into the operations and maintenance manuals and software documentation. At the end of the correction period, continue to notify Owner of software revisions.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT DESCRIPTION

A. The DDC system shall integrate multiple building functions including equipment supervision and control, alarm management, energy management, and historical data collection.

B. The building control system shall include the following:

1. Network DDC panels
2. Network application-specific controllers (ASCs)
3. Personal computer operator workstation(s)

C. The system shall be modular and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC panels, application-specific controllers, and operator devices.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC panel shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Without depending on a control processing device, DDC panels shall be able to:

1. Access any data from or send control commands and alarm reports directly to any other DDC panels or combination of panels on the network.
2. Send alarm reports to multiple operator workstations.

2.2 NETWORKING COMMUNICATIONS

A. The DDC system shall network operator workstations.

1. A high performance peer-to-peer network.
2. An application-specific local area network (LAN).

B. Peer-to-peer network level:

1. Operator workstations and DDC panels shall directly reside on a network such that communications shall be executed directly between DDC panels, directly between workstations, and between DDC panels and workstations on a peer-to-peer basis.

2. Inherent in the system’s design shall be the ability to expand or modify the network either via a LAN, or auto-dial telephone line modem connections, or via a combination of the two networking schemes.

3. All operator devices, either network-resident or connected via modems, shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer network. Access to data shall be based on logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.

4. Network design shall include the following provisions:
   a. Provide high-speed data transfer rates for alarm reporting, quick report generation from multiple controllers and upload/download efficiency between network devices. An alarm occurring at any DDC panel shall display at one or more workstations or alarm printers within 5 seconds.
   b. Support of any combination of DDC panels and operator workstations directly connected to the peer-to-peer network. The network shall support a minimum of 32 devices.
   c. Message and alarm buffering to prevent information from being lost.
   d. Error detection, correction, and retransmission to guarantee data integrity.
   e. Synchronization of real-time clocks, to include automatic daylight savings time updating among all DDC panels.
   f. Commonly available, multiple source, networking components and protocols shall be used to allow the DDC system to coexist with other networking applications such as office automation. ETHERNET and ARCNET are acceptable technologies.
   g. Use of an industry standard IEEE 802.x protocol. Communications must be of a deterministic nature to assure calculable performance under worst-case network loading.

C. Application-specific local area network (LAN):

1. This level communication shall support a family of application-specific controllers and shall communicate bidirectionally with the peer-to-peer network through DDC panels for transmission of global data.

2. Application-specific controllers shall be arranged on the LANs in a functional relationship with DDC panels. For example, a VAV terminal unit controller shall be on a LAN from the DDC panel that is controlling its corresponding AHU.
3. A maximum of 32 application-specific controllers may be configured on each LAN.

D. Communication capability:

1. Automatic communications shall allow DDC panels to communicate with remote operator stations and remote terminals as indicated in the sequence of operations.
2. DDC panels shall automatically communicate with workstations to report alarms or other significant events.
3. Operators at the workstation shall be able to perform all control functions, all report functions, and all database generation and modification functions as described for workstations connected via the network. Routines shall automatically answer communications from remote DDC panels. The fact that communications are taking place with remote DDC panels shall be invisible to an operator.
4. Communications shall use standard web browser via local area network.

2.3 DDC PANEL

A. Microprocessor-based panels with a minimum word size of 16 bits: Multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Each DDC panel shall be capable of operating as a stand-alone controller, performing its specified control functions independently of other controllers in the network. Controller size shall be sufficient to fully meet the requirements of this specification and the point list on the drawings.

B. Each DDC controller shall have sufficient memory, a minimum of 1 megabyte, to support its own operating system and databases, including:

1. Control processes
2. Energy management applications
3. Alarm management applications
4. Historical and trend data for points specified
5. Maintenance support applications
6. Custom processes
7. Operator I/O
8. Communications
9. Manual override monitoring

C. Each DDC panel shall support:

1. Monitoring of the following types of inputs, without the addition of equipment outside the DDC panel:
   a. Analog inputs
(1) 4-20 mA  
(2) 0-10 Vdc  
(3) Thermistors  
(4) 1000-ohm RTDs

b. Digital inputs

(1) Dry contact closure  
(2) Pulse accumulator  
(3) Voltage sensing

2. Direct control of electronic actuators and control devices. Each DDC panel shall be capable of providing the following control outputs without the addition of equipment outside the DDC panel:

a. Digital outputs

(1) Contact closure (motor starters, sizes 1-4)

b. Analog outputs

(1) 0-20 psi  
(2) 4-20 mA  
(3) 0-10 Vdc

D. Additional space for future point connections, each DDC panel: Minimum 10 percent.

1. Provide sufficient internal memory for the specified control sequences with at least 25 percent of the total memory available for future use.

E. Each DDC panel shall have at least two RS-232C serial data communication ports for operation of operator I/O devices.

F. Each DDC panel shall have point discrete, on-board, limited access Hand/Off/Auto operator override switches for digital control type points and gradual switches for analog control type points. These override switches shall be operable whether the panel processor is operational or not. DDC panels shall monitor the status of all overrides and remotely report each override control operation.

G. DDC panels shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.
H. Each DDC panel shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components, and provide both local and remote annunciation of detected component failures, low battery conditions, or repeated failure to establish communication.

I. Provide isolation at each peer-to-peer network termination and each field point termination, to suppress induced voltage transients, meeting requirements of IEEE C62.41.

J. In the event of the loss of normal power, each DDC panel shall shut down in an orderly process which shall prevent the loss of database or operating system software. Provide nonvolatile memory for critical controller configuration data and battery backup sufficient to support the real-time clock and volatile memory for a minimum of 72 hours.

1. Upon restoration of normal power, the DDC panel shall automatically resume full operation without manual intervention.
2. Should DDC panel memory be lost for any reason, reloading the DDC panel shall be possible via the local RS-232C port, via telephone line dial-in, or from an operator workstation.

K. Provide a DDC panel for each AHU or other HVAC system as indicated on the drawings. It is intended that each unique system be provided with its own point-resident DDC panel.

2.4 SYSTEM SOFTWARE

A. General:

1. Provide all necessary software to form a complete control system as described in this specification.
2. The software programs specified in this section shall be integral in DDC panels and shall not be dependent upon any higher-level computer for execution.

B. Control software:

1. The DDC panels shall have the ability to perform the following pre-tested control algorithms:

   a. Two-position control
   b. Proportional control
   c. Proportional plus integral control
   d. Proportional, integral, plus derivative control
   e. Control loop tuning
2. Include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
3. Shall protect against excessive demand during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
4. Upon the resumption of normal power, the control software shall analyze the status of controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operations.

C. DDC panels shall be able to perform any or all of the following energy management routines:

1. Time-of-day scheduling
2. Calendar-based scheduling
3. Holiday scheduling
4. Temporary schedule overrides
5. Start-stop time optimization
6. Automatic Daylight Savings Time switch-over
7. Night setback control

D. DDC panels shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. It shall be possible to use any of the following in a custom process:
   a. Any system measured point data or status
   b. Any calculated data
   c. Any results from other processes
   d. User-defined constants
   e. Arithmetic functions (+, -, *, /, square root, exp, etc.)
   f. Boolean logic operators (and/or, exclusive or, etc.)
   g. On-delay/off-delay/one-shot timers

2. Custom processes may be triggered based on any combination of the following:
   a. Time interval
   b. Time of day
   c. Date
   d. Other processes
   e. Time programming
   f. Events (e.g., point alarms)

3. The custom control programming feature shall be documented in English.

E. Alarm management shall monitor and direct alarm information to operator devices. Each DDC panel shall perform distributed, independent alarm analysis and filtering to
minimize operator interruptions due to noncritical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall the DDC panel’s ability to report alarms be affected by operation of a PC workstation or local I/O device, or by communications among panels on the network.

1. All alarm or point change reports shall include the point’s English language description and the time and date of occurrence.
2. The user shall be able to define the specific system response to alarm at each point. Alarms shall be prioritized. Each DDC panel shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
3. Alarm reports and messages shall be directed to a user-defined list of operator devices.
4. In addition to the point’s descriptor and the time and date, the user shall be able to print, display, or store an alarm message to more fully describe the alarm condition or direct operator response.
5. Operator-selected alarms shall initiate a call to a remote operator device.

F. A variety of historical data collection utilities shall manually or automatically sample, store, and display system data for points as specified in the I/O summary.

1. DDC panels shall store and report point history data for selected analog and digital inputs and outputs. Methods of collection shall be either by a predefined time interval or upon a predefined change of value.
2. DDC panels shall provide high resolution sampling for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary. Provide capability to view or print trend and tuning reports.

G. DDC panels shall automatically accumulate and store run-time hours for digital input and output points as specified in the point I/O summary.

H. DDC panels shall automatically sample, calculate, and store consumption totals on a daily, weekly or monthly basis for user-selected analog and digital pulse input type points as specified in the point I/O summary.

I. DDC panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis for points as specified in the point I/O summary.

2.5 APPLICATION-SPECIFIC CONTROLLERS (ASC)

A. Each DDC panel shall be able to extend its performance and capacity through the use of remote application-specific controllers (ASCs).
B. Each ASC shall operate as a stand-alone controller capable of performing its specified
control responsibilities independently of other controllers in the network. Each ASC
shall be a microprocessor-based, multi-tasking, real-time digital control processor.

C. Terminal equipment controllers:

1. System shall control each piece of equipment through direct connection to a DDC or
ASC. Terminal equipment shall include, but not be limited to, the following:
   a. Variable-air-volume (VAV) terminal units
   b. Constant-air-volume (CAV) terminal units
   c. Unit conditioners (fan-coil units, induction units, pressure-dependent terminal
      units)
   d. Heat pumps (water- or air-source heat pumps)
   e. Unit ventilators

2. Controllers shall include all point inputs and outputs necessary to perform the
specified control sequences. As a minimum, 50 percent of the point outputs (except
for unit ventilator controllers) shall be of the universal type, either modulating or
two-position. Terminal equipment controllers utilizing proprietary control signals
and actuators shall not be acceptable. Provide DDC panels or ASCs with industry
standard outputs for control of terminal equipment.

3. Each controller shall perform its primary control function independent of other DDC
panel LAN communication, or if LAN communication is interrupted. The controller
shall receive its real-time data from the DDC panel time clock and shall ensure LAN
continuity. Each controller shall include algorithms incorporating proportional,
integral, and derivative (PID) gains for all applications. All PID gains and biases
shall be field-adjustable by the user via terminals as specified herein.

4. Provide each terminal equipment controller with sufficient memory to accommodate
point databases, operating programs, local alarming and local trending. All databases
and programs shall be stored in nonvolatile EEPROM, EPROM and PROM, or
minimum of 72-hour battery backup shall be provided. The controllers shall be able
to return to full normal operation without user intervention after a power failure of
unlimited duration. Operating programs shall be field-selectable for specific
applications. Specific applications may be modified to meet the user’s exact control
strategy requirements, allowing for additional system flexibility. Controllers that
require factory changes of applications are not acceptable.

5. Variable-air-volume (VAV) terminal controllers shall support the following types of
pressure independent terminal units as a minimum:
   a. VAV with hot water heating coil

2.6 PERSONAL COMPUTER OPERATOR WORKSTATION
A. Provide personal computer operator workstations for command entry, information management, network alarm management, and database management functions. All real-time control functions shall be resident in the DDC panels.

1. Provide workstation located within Mechanical Room 201.
2. Workstation shall consist of a flat panel color monitor, personal computer with minimum 3 GB RAM, 160-GB hard drive and controller, mouse, 16 x DVD +/- RW, 56.0 Kb modem, and 101-key enhanced keyboard. Personal computer shall have a minimum 2.5 GHZ Intel Pentium Dual Core processor or equivalent by AMD, 10/100/1000 Network Interface with RJ-45 ethernet port.
3. The display provided for system operation shall have a diagonal screen measurement of no less than 19 inches and a minimum display resolution of no less than 1440 x 900 pixels. Separate controls shall be provided for color, contrasts and brightness. The screen shall be nonreflective.

2.7 OPERATOR WORKSTATION SOFTWARE

A. Basic interface description:

1. Operator workstation interface software shall use English-language prompting, English-language point identification, and industry standard PC application software. The software shall provide, as a minimum, the following functions.

   a. Graphical viewing and control of environment.
   b. Scheduling and override of building operations.
   c. Collection and analysis of historical data.
   d. Definition and construction of dynamic color graphic displays.
   e. Editing, programming, storage, and downloading of controller databases.

2. Provide a graphical user interface which shall use a mouse or similar pointing device and “point and click” approach to menu selection. Users shall be able to start and stop equipment or change setpoints from graphical displays with the pointing device.

   a. Provide that all operations can also be performed using the keyboard as a backup interface device.
   b. Provide at least 10 special function keys to perform often-used operations.

3. The software shall provide multi-tasking that allows the user to run several applications simultaneously. The mouse shall be used to quickly select and switch between multiple applications. This shall be accomplished through the use of Microsoft Windows or similar industry standard software that supports concurrent viewing and controlling of systems operations.

4. Multiple-level password access protection shall be provided to allow the user manager to limit workstation control, display, and data base manipulation capabilities.
5. Software shall allow the operator to perform commands including, but not limited to, the following:

   a. Start up or shut down selected equipment
   b. Adjust setpoints
   c. Add/modify/delete time programming
   d. Enable/disable process execution
   e. Lock/unlock alarm reporting for points
   f. Enable/disable totalization for points
   g. Enable/disable trending for points
   h. Override PID loop setpoints
   i. Enter temporary override schedules
   j. Define holiday schedules
   k. Change time/date
   l. Automatic daylight savings time adjustment
   m. Enter/modify analog alarm limits
   n. Enter/modify analog warning limits
   o. View limits

B. Scheduling:

1. Provide a graphical spreadsheet-type format for time-of-day scheduling and overrides of building operations. Provide the following spreadsheet graphic types as a minimum:

   a. Weekly schedules
   b. Zone schedules
   c. Monthly calendars

2. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule. Each schedule shall include columns for each day of the week as well as holiday and special day columns for alternate scheduling on user-defined days. Equipment scheduling shall be accomplished by simply inserting occupied and unoccupied times into appropriate information blocks on the graphic. In addition, temporary overrides and associated times may be inserted into blocks for modified operating schedules. After overrides have been executed, the original schedule will automatically be restored.

3. Provide zone schedule for each building zone. Each schedule shall include all commandable points residing within the zone. Each point may have a unique schedule of operation relative to the zone’s occupancy schedule, allowing for sequential starting and control of equipment within the zone. Scheduling and rescheduling of points may be accomplished easily via the zone schedule graphic.
4. Monthly calendars for a 24-month period shall allow scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

C. Collection and analysis of historical data:

1. Trending capabilities shall allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting.
2. Trend data report graphics shall allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of at least 6 points. Provide additional functionality to allow any trended data to be transferred easily to an off-the-shelf spreadsheet package. This shall allow the user to perform custom calculations such as energy use, equipment efficiency, and energy costs and shall allow for generation of these reports on high-quality plots, graphs, and charts.

D. Dynamic color graphic displays:

1. Color graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units, terminal units and hot water boiler systems, shall be provided as indicated in the point I/O summary to optimize system performance analysis and speed alarm recognition.
2. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, or text-based commands.
3. Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.
4. The environment of the PC operator workstation shall allow the user to simultaneously view several graphics at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
5. Graphic generation software shall allow the user to add, modify, or delete system graphic displays.

E. System configuration and definition:

1. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
2. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:
a. Add/delete/modify DDC panel
b. Add/delete/modify operator workstations
c. Add/delete/modify application-specific controllers
d. Add/delete/modify points of any type and all associated point parameters and tuning constants
e. Add/delete/modify alarm reporting definition for points
f. Add/delete/modify control loops
g. Add/delete/modify energy management applications
h. Add/delete/modify time and calendar-based programming
i. Add/delete/modify totalization for points
j. Add/delete/modify historical data trending for points
k. Add/delete/modify custom control processes
l. Add/delete/modify any and all graphic displays, symbols and cross-reference to point data
m. Add/delete/modify dial-up telecommunication definition
n. Add/delete/modify all operator passwords
o. Add/delete/modify alarm messages

F. Additional workstation software:

1. Automatic communications shall include the following features as a minimum:
   
a. Manual communication from the workstation to remote networks shall be accomplishable using only a mouse to select and request the desired remote connection.
   b. Alarms shall automatically communicate with the workstation for display at the terminal and for hard-copy printout at the associated event printer.
   c. Alarms shall, at the operator’s option, communicate with a stand-alone printer to provide for real-time alarm printouts even when the workstation is off-line (such as when it is being used to run operator-selected third party software).
   d. Trend data shall be scheduled for automatic updating to the workstation at operator-selected times. The operator shall also have the option of manually collecting trend data at any time.

PART 3 - EXECUTION

3.1 HARDWARE AND SOFTWARE INSTALLATION

   A. Install the control system in accordance with manufacturer’s instructions, complete and operating as shown and specified.

   B. See drawings for the level of controller required for each type system control.

3.2 TESTS
A. Installer shall test, calibrate, and adjust system and perform final field test. Engineer shall witness tests.

B. Final field test:

1. Sensors: Cross-check each sensor by comparing the reading at the sensor to a standard traceable to the National Institute of Standards and Technology (NIST).
2. Control points: Cross-check each control point by comparing the control command to the field-controlled device.
3. Verify that systems are operable from local controls in the specified failure mode upon panel failure or loss of power.
4. Submit test results as required in “Submittals” in Part 1 above.

C. Compliance inspection: Schedule compliance inspection only after installer has conducted all the test operations required above and successfully completed them, as substantiated by the required submittals. Conduct the compliance inspection with the Owner’s designated representative and the Engineer. Conduct each activity described on the “Compliance Inspection Checklist” attached at the end of this Section. When each activity is satisfactorily completed, the Owner’s representative (user) and the Engineer (A/E) will initial and date the line provided on the checklist.

1. If any item on the checklist cannot be complied with, submit a written explanation.
2. Complete the checklist and submit as required in “Submittals” in Part 1.

3.3 OPERATING INSTRUCTIONS

A. Coordinate instruction period with requirements of Section 23 0500.

B. Provide competent instructors to give full instruction to designated personnel in the adjustment, operation, and maintenance of the system installed, rather than a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. Training shall be held during normal work hours of 8:00 a.m. to 4:30 p.m. weekdays as follows:

C. Provide one 8-hour day of training for Owner’s operating personnel. Training shall include:

1. Explanation of drawings, operations, and maintenance manuals.
2. Walk-through of the job to locate control components.
3. Operator workstation and peripherals.
4. DDC panel and ASC operation/function.
5. Operator control functions including graphic generation and field panel programming.
6. Operation of portable operator’s terminal.
7. Explanation of adjustment, calibration, and replacement procedures.
D. Provide 4 hours of additional training quarterly for a period of one year from final completion of the project.

E. The Owner may require personnel to have more comprehensive understanding of the hardware and software. Additional training shall be available from the installer, after completion of the work of the project. Provide description of available local and factory customer training.

END OF SECTION
Compliance Inspection Checklist follows Section.
COMPLIANCE INSPECTION CHECKLIST

Project: __________________________________________________
________________________________________________
________________________________________________
________________________________________________

1. Manually generate an alarm at a remote DDC panel to demonstrate the capability of the workstation and alarm printer to receive alarms within 5 seconds.

User________________ Date_____________ A/E____________ Date____________

2. Disconnect an operator workstation in the central control room and manually generate an alarm at a remote DDC panel to demonstrate the capability of the system printer to receive alarms when the workstation is disconnected from the system.

User________________ Date_____________ A/E____________ Date____________

3. Disconnect one DDC panel from the network to demonstrate that a single device failure shall not disrupt or halt peer-to-peer communication. Panel to be disconnected shall be selected by the Engineer.

User________________ Date_____________ A/E____________ Date____________

4. At a DDC panel of the Engineer’s choice, display on the portable operator’s terminal:

a. At least one temperature setpoint and at least one status condition, (for example, on or off for a system or piece of equipment attached to that panel), as well as for points at another DDC panel on the network.

b. The diagnostic results as specified for a system or piece of equipment attached to that panel as well as for a system or piece of equipment attached to another DDC panel.

c. The ability to add a new point to the DDC panel with the POT and have it automatically uploaded to the workstation to modify that panel’s stored database.

User______________ Date_______________ A/E_____________ Date_____________

5. At an ASC of the Engineer’s choice, disconnect the LAN connection to demonstrate its lack of reliance on a DDC panel to maintain full control functionality.

User______________ Date_______________ A/E_____________ Date_____________

END OF CHECKLIST
SECTION 23 11 26 - LIQUEFIED-PETROLEUM GAS PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping, specialties, and accessories for liquefied petroleum (LP) gas systems within building and to point indicated.

1.2 RELATED SECTIONS

A. Pipe assembly: Section 23 05 00.

1.3 UTILITY CONNECTION

A. New gas service and underground liquid propane tank will be installed by Suburban Propane. Make arrangements for, and have this service installed, at the appropriate scheduled time.

1.4 SUBMITTALS

A. Product data: Pipe, valves, fittings and accessories.

B. Certifications: Test and approval of gas piping installation by the authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

B. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

1.6 REGULATORY REQUIREMENTS

A. Installation of gas piping shall meet requirements of the authority having jurisdiction, the gas supplier for gas service, and NFPA 54 and NFPA 58.

B. Upon completion of the work, the piping shall be tested as required by inspection authorities having jurisdiction.
PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Aboveground pipe: Black steel, ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40.

B. Steel pipe fittings:
   1. Threaded: Malleable iron or black steel, ASME B16.3 Class 150, with pipe joint compound approved for gas service for PTFE tape.

C. Underground pipe: Polyethylene pipe (PE), ASTM D 2513, SDR 11.
   1. Fittings:
      a. Socket type: ASTM D 2683, heat fusion type.
      b. Butt type: ASTM D 3261, with dimensions matching PE pipe.
   2. Pipe and fittings shall be marked "ASTM D 2513.

2.2 GAS VALVES

A. NPS 2 (DN 50) and smaller: Ball valve equal to Conbraco Industries "Apollo 80" Series, Watts 6000 Series or equal by ASCO; UL approved and listed for natural and LP gas service.
   1. Material: Bronze.
   2. Rating: 400 psi WOG nonshock.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping as indicated on the drawings, in accordance with the regulations of the local authority and local gas company, and in accordance with installation and testing requirements of Section 23 05 00.

B. Take branches from horizontal runs from side or top of such runs. A tee shall be placed at the bottoms of risers in gas piping. Bottom of tee shall be provided with a three-inch-long nipple and cap the same size as riser. When riser is concealed, the cap shall project through wall to be accessible and shall be properly marked with engraved plastic nameplate, "DANGER, GAS, CLEANOUT". Red background with white letters.
C. Purge gas lines to equipment when the gas is turned on from the gas supply.

D. Provide cast-iron sleeve where line enters the building.

E. Install valves and specialties readily accessible for operation and maintenance, with ample clearance for turning wheel handles or operators.

F. Valves are not permitted in accessible ceiling space whether or not used as air plenums.

G. Install valves at house side of each meter and in each connection to equipment, accessible and adjacent to the equipment. Install valves in branch lines as indicated on drawings.

H. Vents:

1. Provide vent lines to the outside of the building. Provide vents in accordance with the regulations of the local authority and local gas company. Vents are required on main gas regulators, pilot regulators, high- and low-pressure switches, diaphragm gas valves, and dump valves.

2. Route each vent separately to the outside of the building and terminate in a screened, turned-down elbow.

3. Vents shall not terminate below any window, door, air intake, or opening to the building. Dump-valve vent shall terminate at the highest possible point outside to prevent nuisance gas leak complaints.

END OF SECTION
SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Heating water piping.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Control valves: Section 23 09 08.

B. Insertion wells for control devices and sensors: Section 23 09 13.

C. Flow switches: Section 23 09 13.

D. Differential pressure sensors: Section 23 09 13.

1.3 RELATED SECTIONS

A. Piping installation, and testing: Section 23 05 00.

B. Specialties: Section 23 05 08.

1.4 REFERENCES

A. Steel piping and fittings:

1. ASME B 16.3: Malleable Iron Threaded Fittings
2. ASME B 16.9: Factory-Made Wrought Steel Butt Welding Fittings
3. ASME B 16.39: Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300
4. ASTM A 53/ A 53M: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
5. ASTM A 536: Standard Specification for Ductile Iron Castings

B. Copper piping and fittings:

1. ASME B 16.18: Cast Copper Alloy Solder Joint Pressure Fittings
2. ASME B 16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASTM B 75/ B75M: Standard Specification for Seamless Copper Tube
4. ASTM B 88: Standard Specification for Seamless Copper Water Tube
5. ASTM B 584: Standard Specification for Copper Alloy Sand Castings for General Applications
C. Flanges:
   1. ASME B 16.5: Pipe Flanges and Flanged Fittings, NPS 1/2 to NPS 24

D. Grooved fittings:
   1. ASTM F1476: Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications

1.5 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.6 QUALITY ASSURANCE

A. The pipe manufacturer shall certify piping to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

B. All grooved couplings and fittings shall be the products of a single manufacturer. Grooving tools shall be approved by grooved component manufacturer.

C. Date stamp all castings used for coupling housings for quality assurance and traceability.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Dielectric fittings:
   1. Anvil International
   2. Elster Perfection Corporation
   3. Precision Plumbing Products, Inc.
   5. Victaulic Company of America

2.2 PIPE

A. Steel: Black steel, ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40.

B. Copper: ASTM B 88, Type L hard drawn.
2.3 FITTINGS

A. General requirements for fittings:

   1. Elbows in piping NPS 4 (DN 100) and larger shall be long radius type.

B. Welded and flanged fittings for steel pipe:

   2. Companion flanges: ASME B16.5, Class 150, welding neck or slip-on type.
   3. Gaskets for flanged joints: Cross-laminated long fiber composition suitable for the service, temperature, pressure and liquid with which they come in contact.

C. Threaded fittings for steel pipe:

   1. Malleable iron, Class 150, ASME B16.3.

D. Unions for steel pipe:

   1. Malleable iron, Class 150, ASME B16.39, ground bronze seats, threaded ends.

E. Rolled groove mechanical couplings and fittings for steel pipe:

   1. General:

      a. Manufactured in accordance with ASTM F 1476.
      b. Capable of withstanding 350 psig (2413 kPa) working pressure at 230 degrees F (110 degrees C).
      c. Manufactured in ASTM A53 pipe sizes.
      d. Note: Mechanical-T outlets are not permitted.

   2. Grooved-end fittings:

      a. ASTM A 536, Grade 65-45-12 ductile iron coated with orange colored alkyd enamel.
      b. Construct to accept grooved-end couplings of same manufacturer.
      c. Reducing couplings not permitted; use reducing fittings at changes in pipe size.
      d. Equal to Victaulic grooved end fittings.

   3. Rigid type couplings:
a. Housing: ASTM A 536 Grade 65-45-12 ductile iron two-piece cast housing, secured with carbon steel nuts and bolts, coated with orange colored alkyd enamel.
b. Gasket: EPDM.
c. Equal to Victaulic Style 107N for NPS 2 (DN 50) through NPS 12 (DN 300).
d. Equal to Victaulic AGS Series, Style W07 for NPS 14 (DN 350) through NPS 24 (DN 600).

4. Mechanical flange adapters:
   a. Flange adapter: ASTM A 536 ductile iron, hinged two-piece design with electroplated steel bushing, coated with orange colored alkyd enamel.
   b. Gasket: EPDM.
   c. Equal to Victaulic Style 741 for ASME/ANSI B16.1 Class 125 and ASME/ANSI B16.5 Class 150 bolt-hole pattern.
   d. Equal to Victaulic Style 743 for ANSI Class 300 bolt-hole pattern.

F. Cast or wrought fittings for copper pipe:
   1. Fittings for plain end copper pipe: Solder joint, cast brass, ASME B16.18; or wrought copper, ASME B16.22.

G. Unions for copper pipe: Either of the following:
   1. Brass, Class 150 minimum, metal-to-metal seating, solder-joint ends.
   2. Wrought copper, Class 150 minimum, metal-to-metal seating, ASME B16.22, solder-joint ends.

H. Rolled groove mechanical couplings and fittings for copper pipe:
   1. General:
      a. Manufactured in accordance with ASTM F 1476.
      b. Capable of withstanding 300 psi (2070 kPa) working pressure at 230 degrees F (110 degrees C).
      c. Manufactured in copper tube sizes.
      d. Note: Mechanical-T outlets are not permitted.
   2. Grooved-end fittings:
      a. ASME B 16.22 wrought copper and ASTM B 75 copper tube, or ASTM B 16.18 and ASTM B 584 bronze casting.
      b. Construct to accept grooved-end couplings of same manufacturer.
      c. Reducing couplings not permitted; use reducing fittings at changes in pipe size.
      d. Equal to Victaulic grooved fittings for copper.
3. Rigid type couplings:
   a. Housing: ASTM A 536 ductile iron two-piece cast housing, secured with carbon steel nuts and bolts, coated with copper colored alkyd enamel.
   b. Gasket: EPDM.
   c. Equal to Victaulic Style 607.

4. Mechanical flange adapters:
   a. Flange adapter: ASTM A 536 ductile iron, hinged two-piece design with electroplated steel bushing, ASME/ANSI B16.5 Class 125 and ASME/ANSI B16.5 Class 150, coated with orange colored alkyd enamel.
   b. Gasket: EPDM.
   c. Equal to Victaulic Style 641.

2.4 DIELECTRIC FITTINGS

A. Dielectric nipples:
   1. General: Completely isolate dissimilar metals so that electric current is below 1 percent of the galvanic current which would exist with metal-to-metal contact. Gaskets approved for the medium carried by the piping system.
   2. Dielectric nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining, plain or threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 degrees F (107 degrees C).

B. Dielectric fittings for grooved piping joints:
   1. "Dielectric Waterway Fittings" equal to Victaulic Co. "Clearflow" steel threaded ends or thread to Victaulic groove with opaque, high-temperature thermoplastic copolymer liner designed for use at temperatures up to 225 degrees F (107 degrees C) and pressure up to 300 psi (2068 kPa). Complete with ring groove to lock steel casing to plastic liner.

PART 3 - EXECUTION

3.1 GENERAL

A. Install piping as indicated on the drawings and in accordance with provisions of Section 23 05 00 and the piping installation schedule at the end of the Section.

B. Install control valves furnished under Section 23 09 08, Control Valves.
C. Install insertion wells, and differential pressure sensors furnished under Section 23 09 13, Instrumentation and Control Devices for HVAC.

D. Provide piping for accessories for equipment connected to systems with the same piping as is specified for the system.

E. Provide boiler trim piping connections to low water cutoffs with crosses instead of tees and elbows. Plug the unused openings of crosses to serve as cleanouts. Provide boiler blowdown piping with shut off valve to discharge into drain.

F. Provide unions or flanges and gaskets at control valves, final connections to equipment and elsewhere as indicated to facilitate disconnecting piping without pipe damage.

3.2 ROLLED GROOVE FITTINGS

A. Install grooved joints in accordance with the manufacturer’s latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service.

B. A factory-trained field representative (direct employee) of the mechanical joint manufacturer shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products. A distributor's representative is not considered qualified to conduct the training.

3.3 DIELECTRIC FITTINGS

A. Provide dielectric nipples between copper and steel piping or equipment connections.

B. As an option for grooved joint piping, provide dielectric waterway fittings.

C. Provide dielectric flanges with isolation sleeves for bolts and isolation washers on each side of flanged connection at flanged points of connection between ferrous piping and copper piping.

3.4 SCHEDULES

(See schedule, next page)
A. Steel pipe with threaded fittings; NPS 2 (DN 50) and smaller.
B. Steel pipe with welded or flanged fittings; NPS 2.5 (DN 65) and larger.
C. Steel pipe with rolled groove mechanical coupling and fittings; NPS 2 and larger.
D. Copper pipe with cast or wrought fittings; NPS 2 (DN 50) and smaller.
E. Copper pipe with cast or wrought fittings; NPS 2.5 (DN 65) and larger.
F. Copper pipe with rolled groove mechanical couplings and fittings; NPS 2.5 through 8 (DN 65 through 200).
SECTION 23 21 23 - HVAC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. In-line circulator pumps.
B. Vertical in-line pumps.

1.2 RELATED SECTIONS

A. Motor: Section 23 05 13.
B. Power factor correction: Section 23 05 13.
C. Vibration-control supports: Section 23 05 48.
D. Variable frequency drives: Section 26 29 23.

1.3 SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, performance curve at trimmed impeller diameter and scheduled performance point, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Include data verifying compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.

C. Unit shown on drawings is based on the dimensions of the design basis unit specified in Part 2 below. If another acceptable manufacturer’s unit should be proposed, ascertain that it will fit in the available space. Include, with shop drawings of the unit, scale drawings similar to the contract drawings, including plans, and sections, showing any changes in the wiring, arrangement, or access necessary to accommodate the unit furnished.

D. Shop drawings shall show complete dimensions of complete assembled unit with accessories.

E. Include wiring diagram showing factory and field wiring.

1.4 QUALITY ASSURANCE
A. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

B. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

C. Department of Energy (DOE) compliance: Pump manufactures shall comply with US Department of Energy (DOE) energy conservation standard that pertains to applicable pumps with 1 horsepower or greater. These pumps shall be evaluated using the Pump Energy Index (PEI) that determines the efficiency rating and DOE compliance. The lower the number the higher the efficiency.

1. Pumps shall have a PEI rating of 1 or less to comply with the standard.
2. The PEI compliant rating shall appear on the pumps permanent nameplate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled product, or comparable product by one of the following:

B. In-line circulator pumps:
   1. Armstrong Pump Co.
   2. Aurora Pumps
   3. ITT Bell and Gossett
   4. Paco Pumps; Grundfos Group
   5. Patterson Pump Co.
   6. Taco Inc.
   7. Thrush Company, Inc.

C. Vertical in-line pumps:
   1. Armstrong Pump Co.
   2. Aurora Pumps
   3. ITT Bell and Gossett
   4. Paco Pumps; Grundfos Group
   5. Patterson Pump Co.
   6. Taco Inc.
   7. Thrush Company, Inc.
   8. Weinman Pump Co.

2.2 PUMPS, GENERAL

A. Pump shall have capacities and electrical characteristics shown on the drawings.
B. Pumps shall be factory-assembled and factory-tested.

C. Single-phase motors shall be permanent split-capacitor type with built-in thermal overload protection.

D. Pumps shall comply with the DOE Energy Conservation Standard with a PEI rating of 1 or less.

2.3 IN-LINE CIRCULATOR PUMPS

A. General description: Horizontal, in-line, centrifugal, separately-coupled, single-stage, radially split-case design, resiliently mounted motor, bronze fitted with overhung impeller. Pumps and seals shall be rated for continuous operation at a minimum working pressure of 175 psig (1200 kPa) and a minimum temperature of 250 degrees F (120 degrees C).

B. Casing:

1. Cast iron.
3. Casings shall allow removal and replacement of impellers without disconnecting piping.

C. Impeller: ASTM B584 cast bronze, statically and dynamically balanced, closed, overhung, single-suction, and keyed to shaft.

D. Seals: mechanical with carbon steel rotating ring, stainless steel spring, and ceramic seat.

E. Shaft and sleeve: Steel shaft and cupro-nickel sleeve.

F. Bearings: Permanently lubricated enclosed replaceable ball bearings.

G. Couplings: Axially split spacer coupling.

2.4 VERTICAL IN-LINE PUMPS

A. Armstrong 4300 Series, Taco Series KS, ITT Bell and Gossett Series e-80SC.

B. General description: Vertical, in-line, centrifugal, separately-coupled, single-stage, bronze-fitted design with overhung impeller. Pumps and seals shall be rated for continuous operation at a minimum working pressure of 175 psig (1200 kPa) and a minimum temperature of 250 degrees F (120 degrees C).

C. Casing:
1. Cast iron.
3. Casings shall allow removal and replacement of impellers without disconnecting piping.
4. Threaded gauge taps at inlet and outlet flange connections.
5. Threaded taps for seal flushing piping.
6. Threaded drain plug at the bottom of volute.
7. Replaceable bronze wear ring.

D. Impeller: ASTM B584 cast bronze, statically and dynamically balanced, closed, single suction, and keyed to shaft and secured with a locking cap screw. Trim impellers to exceed scheduled flow and head by fifteen percent.

E. Seals: Internally flushed (self-flushing) type mechanical seals with carbon steel rotating ring, stainless steel spring, ceramic seat, and flexible bellows and gasket. Provide seal flushing piping from pump discharge to seal flushing inlet tap.

F. Shaft and sleeve: Ground and polished stainless-steel shaft with bronze sleeve.

G. Bearings: Oil lubricated; bronze-journal or thrust type bearings.

H. Couplings: Axially split spacer coupling.

I. Motor: Provide with lifting eyebolt.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide balancing valve in discharge piping for reading flow rate. Flow rate shall be adjusted using balancing valve for pumps that do not have variable frequency drives. Flow rate shall be adjusted using variable speed drives where they are provided, with balancing valve fully open.

B. Provide center-guided, spring-loaded silent-action check valves in discharge piping.

C. Provide valves for pump isolation on the suction and discharge side of each pump.

D. Provide gauge taps at the inlet of each pump inlet strainer.

3.2 IN-LINE CIRCULATOR PUMPS

A. Support:
1. Support in-line circulator pumps from piping.
2. Provide support for piping near the pump inlet and the pump outlet.
3. Provide hangers with sufficient capacity to support the piping and the pump.
4. Provide additional support for pump and motor where required by the manufacturer’s recommendations.

B. Provide gauge taps in the piping at the inlet and outlet of each pump.

3.3 VERTICAL IN-LINE PUMPS

A. Support:

1. On slab on grade, support the pump assembly from a concrete equipment foundation according to the manufacturer’s recommendations, utilizing direct support with the bottom of the pump casing, and pipe saddle supports or stanchion plates supporting piping and accessories directly and rigidly connected to the pump. Provide vibration isolation between the pump assembly and the foundation as specified in the Division 23 Section “Vibration Control Supports for HVAC”.
2. On floors above grade, mount pump assembly on isolation base according to the manufacturer’s recommendations and provide vibration isolators between the base and the floor as specified in the Division 23 Section “Vibration Control Supports for HVAC”.
3. When hung from building structure, support the pump assembly with pipe hangers and supports that are supporting piping and accessories directly and rigidly connected to the pump. Provide spool pieces of piping where necessary to receive hangers and supports.

B. Provide flexible connections between pump assembly and distribution piping.

3.4 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

B. Provide at least one hour of additional instruction time for the equipment specified in this section.

END OF SECTION
SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Refrigerant piping and accessories for equipment in related sections.

1.2 RELATED SECTIONS

A. Piping materials and methods: Section 23 05 00.

B. Piping hangers and supports: Section 23 05 29.

C. Equipment:

2. Ductless split-system units: Section 23 81 27.

1.3 REFERENCES

A. Air Conditioning, Heating, and Refrigeration Institute

1. AHRI 495: Performance Rating Of Refrigerant Liquid Receivers
2. AHRI 730: Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers
3. AHRI 750: Thermostatic Refrigerant Expansion Valves
4. AHRI 760: Performance Rating of Solenoid Valves for Use with Volatile Refrigerants

B. American Society of Testing and Materials

1. ASTM B 280: Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

C. American Society of Mechanical Engineers/American National Standards Institute

1. ASME/ANSI B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

D. American Society of Refrigerating and Air-Conditioning Engineers

2. ASHRAE Standard 34: Designation and Classification of Refrigerants

E. American Welding Society

1. AWS A5.8/A5.8M: Specification for Filler Metals for Brazing and Braze Welding

F. Society of Automotive Engineers

1. SAE J533: Flares for Tubing

G. UL

1. UL 429: Standard for Safety Electrically Operated Valves

1.4 DESIGN REQUIREMENTS

A. Refrigerant piping shall be sized by the manufacturer of the refrigeration compressor, as specified in sections describing refrigeration equipment.


1.5 SUBMITTALS

A. Product data:

1. Piping, fittings, brazing filler metal, brazing flux, and pipe joint compound.
2. Each type of valve, including materials, classifications, arrangement, dimensions and required clearances, and installation instructions.
3. Each type of device and accessory.

B. Shop drawings:

1. Pre-charged tubing, including sizes and approximate lengths of lines.
2. Built-up system piping diagram, including sizes, details, and accessories.
3. Submit system design pressures for use in testing system. In accordance with the International Mechanical Code, "Field Test" for refrigeration systems, including the pressures listed on the condensing unit, compressor, or compressor unit nameplate, and the settings of pressure relief devices.

C. Certifications: Provide certificate of field tests in a form acceptable to the authority having jurisdiction, as part of the permit and inspection records. Certificate shall include no less than:
1. Name of refrigerant.
2. Field test pressure applied to high and low sides of the system.
3. Signature and printed name of the installer.

1.6 QUALITY ASSURANCE

A. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Refrigerant: R-410A.

2.2 PIPING (PRE-CHARGED TUBING SYSTEM)

A. Refrigerant pipe: Pre-charged Type L soft drawn, pre-insulated seamless copper tubing, ASTM B 280.

2.3 PIPE AND FITTINGS (BUILT-UP SYSTEMS)

A. Refrigerant pipe: ASTM B 280 Type ACR hard-drawn seamless copper tubing.


C. Brazing Filler Metals: AWS A5.8/A5.8M.
   1. Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
   2. Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

D. Brazing Flux: Non-corrosive.

E. Threaded pipe joint compound: Pipe joint compound recommended by the manufacturer for use at the temperature and pressure of the system.

F. Threaded pipe joint tape: Polytetrafluoroethylene (PTFE) pipe thread tape, "Teflon."

2.4 ACCESSORIES (BUILT-UP SYSTEMS)

A. System: Provide the listed accessories as a minimum on each built-up system, in accordance with approved shop drawings and as recommended by the refrigeration equipment manufacturer. Accessories provided by the equipment manufacturer with the equipment are acceptable.
B. Isolation valves:

1. Forged brass body ball valve.
2. Full port.
3. Extended copper connections suitable for brazing.
5. Polytetrafluoroethylene PTFE seals, “Teflon”.
7. Blow out proof stem.
8. Double O-ring stem seals.
10. Factory tested.
11. UL listed.

C. Check valves:

1. Body: Forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted forged brass, or cast bronze; or brass hex plug.
5. End Connections: socket or threaded.
6. Maximum Opening Pressure: 0.50 psig (3.4 kPa).

D. Service valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
4. End Connections: Copper spring.

E. Solenoid Valves:

1. Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and a coil compatible with the control signal and available power.

F. Safety Relief Valves:

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by a National Recognized Testing Laboratory.
2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
5. End Connections: Threaded.

G. Thermostatic Expansion Valves:

1. Comply with AHRI 750.
2. Body, Bonnet, and Seal Cap: Forged brass or steel.
5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
7. Superheat: Adjustable.
8. Provide reverse-flow option for heat-pump applications.

H. Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.

I. Moisture/Liquid Indicators:

2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
5. End Connections: Socket or flare.

J. Filter Dryers:

1. Comply with AHRI 730.
2. Replaceable-Core
4. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
6. Provide units designed for reverse flow for heat-pump applications.

K. Flexible Connectors:

2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
5. Maximum Operating Temperature: 250 degrees F (121 degrees C).

L. Mufflers:

2. End Connections: Socket or flare.

M. Receivers:

1. Comply with AHRI 495.
2. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
3. Comply with UL 207; listed and labeled by an NRTL.
5. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
6. End Connections: Socket or threaded.

N. Liquid Accumulators:

1. Comply with AHRI 495.
2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or threaded.
5. Maximum Operating Temperature: 275 degrees F (135 degrees C).

PART 3 - EXECUTION

3.1 INSTALLATION (GENERAL)

A. Install piping as indicated on the drawings and in accordance with provisions of Section 23 05 00 and the piping installation schedule at the end of the Section.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Actual size and configuration of refrigerant piping shall be in conformance with the recommendations of the refrigeration equipment manufacturer.

C. Install refrigerant piping according to ASHRAE Standard 15.

D. Hang horizontal piping NPS 2 (DN 50) and smaller using a metal framing system, clamps, and insulation inserts in accordance with Section 23 05 29.

E. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

H. Install piping adjacent to machines to allow service and maintenance.

I. Install piping free of sags and bends.

J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment.

M. Install valves and specialties in accessible locations to allow for service and inspection.

N. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

3.2 INSTALLATION (PRE-CHARGED TUBING)

A. Install piping as shown on drawings and in accordance with manufacturer's instructions and approved shop drawings.

3.3 INSTALLATION (BUILT-UP SYSTEM)

A. Install piping as shown on drawings and in accordance with manufacturer's instructions and approved shop drawings.

B. Brazed joints:
   1. Install piping with brazed joints where possible.
   2. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation. To permit flow and to avoid pressure build-up, make sure one end of the pipe is open.

C. Flared fittings:
   1. Install piping with flared joints where required for connections.
   2. Flare joints shall conform to SAE J533.

D. Threaded joints:
   1. Install piping with threaded joints where required for connections.
2. Make threaded connections with pipe joint compound approved for the service, or "PTFE" tape.

E. Isolation valves:

1. Provide isolation valves in suction and discharge lines of compressors.
2. Provide isolation valves on inlet and outlet side of filter dryers. Provide an additional isolation valve and pipe and fittings to bypass the filter dryer.

F. Check valves: Install a check valve at the compressor discharge.

G. Service valves:

1. Provide service valves to enable pressure testing, refrigerant charging, and system evacuation.
2. Provide service valves between isolation valves and compressor suction connections if they not an integral part of the isolation valves or compressor equipment.
3. Provide service valves for gage taps at inlet and outlet of strainers if they are not an integral part of valves and strainers.

H. Solenoid valves:

1. Provide solenoid valves upstream from each expansion valve.
2. Provide solenoid valves in horizontal lines with coil at top.

I. Safety relief valves:

1. Install safety relief valves where required by the ASME Boiler and Pressure Vessel Code.
2. Vent safety relief valves to the atmosphere in accordance with ASHRAE Standard 15 and ASHRAE Standard 34.

J. Thermostatic expansion valves:

1. Provide thermostatic expansion valves as close as possible to distributors on evaporators.
2. Install valve so diaphragm case is warmer than bulb.
3. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

K. Strainers: Provide strainers upstream from and adjacent to solenoid valves and thermostatic expansion valves, unless they are furnished as an integral assembly for the device being protected.
L. Moisture/Liquid Indicators: Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

M. Filter driers: Provide filter dryers in liquid line between compressor and thermostatic expansion valve.

N. Flexible connectors: Provide flexible connectors at compressor connections.

O. Muffler: Provide muffler on the discharge side of the compressor, between the flexible connector and the condenser.

P. Receivers: Provide receivers sized to accommodate pump-down charge.

Q. Liquid accumulators: Provide liquid accumulator at compressor suction.

3.4 LEAK TEST

A. After the refrigeration systems have been installed, perform a leak test before evacuating the systems.

   1. The cylinder of oil-pumped nitrogen shall be equipped with a shutoff valve, pressure reducing valve, cylinder pressure gauge, line pressure gauge, and bleed valve.

B. Remove controls or relief valves which could be damaged by test pressures.

C. Separate the high side from the low side and bleed in enough refrigerant to raise the system pressure to 12 to 15 psig (83 to 103 kPa). Then, using oil-pumped dry nitrogen, raise the pressures to the test pressures established as required in "Submittals" in Part 1 above.

D. Test the entire system for leaks.

E. Bleed off the pressure into cylinders, in accordance with ASHRAE Standard 147, and repair leaks. Do not attempt to repair a leak while the system is under pressure. Do not repair bad joints by remelting and adding more brazing material. Take joint apart, thoroughly clean, and remake as a new joint.

F. Retest the system if a leak is found.

G. When tests and repairs are complete, replace valves or controls removed for protection.

H. Submit test certificate required in "Submittals" in Part 1 above.
3.5 EVACUATION

A. To evacuate the system, use a vacuum pump capable of producing at least 1 mm (0.039 inches) mercury absolute vacuum. Proceed as follows:

1. Connect an accurate high vacuum gauge (Micron), such as a Stoke's or Zimmerli gauge, to the system. Do not use compound gauges.
2. Connect the vacuum pump to both the high and low sides of the system. Leave the compressor suction and discharge valves closed. Evacuate the system to 2.5 mm (0.098 inches) mercury absolute. Keep ambient air temperatures above 60 degrees F (15.6 degrees C) during the evacuation process.
3. Break the system vacuum with oil-pumped dry nitrogen. Open the compressor suction and discharge service valves and re-evacuate the system to 2.5 mm (0.098 inches) mercury absolute.
4. After the system has been double evacuated to 2.5 mm (0.098 inches) mercury absolute, close the vacuum-pump suction valve and stop the pump. Allow the system to stand under a vacuum a minimum of 12 hours and recheck the vacuum. Notify the Architect in time for him to verify the test pressure at beginning and end of time limit, before proceeding to charge the system.

3.6 CHARGING

A. Charge the system with refrigerant through the liquid-line charging valve. Use a clean strainer-drier in the charging line, along with a pressure gauge and shut-off valve to control pressures. Before starting the compressor, ascertain that the oil sight glass, if provided, is 75 percent full, and suction and discharge valves back-seated.

3.7 FINAL START-UP PROCEDURE

A. Check out operating and safety controls in accordance with the compressor manufacturer's recommendations.

B. Recheck the oil level in the sight glass at frequent intervals. It should not drop below 50 percent level.

C. Adjust compressor suction unloaders, if provided, for proper evaporator-compressor balance to maintain the scheduled minimum discharge temperature.

D. Reinspect the system after it has been in normal operation for at least 72 hours. At this time, instruct the Owner in the operation and maintenance of the equipment, as required in the equipment section.
3.8 LUBRICATION

A. If it becomes necessary to add oil to the system, use only the oil recommended by the compressor manufacturer.

3.9 SCHEDULES

| REFRIGERANT PIPING INSTALLATION SCHEDULE |
|------------------------|------------------|------------------|
|                        | Pre-charged Tubing System | Built-up System |
| System Capacity Dependent Piping Applications |
| Split-system air conditioning units over 5 tons |     | X               |
| Ductless split-systems 5 tons and less          | X    | X               |

END OF SECTION
SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC supply, return, and exhaust metal ductwork and plenums in pressure classes from minus 2 to plus 10 inches wg (minus 500 to plus 2490 Pa).

B. Single-wall round duct.

C. Acoustical duct lining.

D. Special ductwork for laundry dryers.

E. Sealants.

F. Air duct leakage testing.

G. Cleaning of existing duct systems.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Firestopping: Division 07.

B. Flashing ducts through roof: Section 23 05 06.

C. Insulation: Section 23 07 13.

D. Louvers and vents: Division 08.

E. Balancing: Section 23 05 93.

1.3 REFERENCES

A. SMACNA HVAC DCS: SMACNA HVAC Duct Construction Standards, Metal and Flexible.

B. SMACNA RIDCS: SMACNA Round Industrial Duct Construction Standards.


E. ASTM C 423: Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

F. ASTM C 1071: Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

G. ASTM D 1330: Rubber Sheet Gaskets.


K. UL 181: Factory-Made Air Ducts and Air Connectors.

1.4 DEFINITIONS

A. Seam: Joining of two longitudinal (parallel to the direction of airflow) edges of duct surface material. All other duct surface connections are joints.

B. Joints: Transverse joints (perpendicular to the direction of airflow); branch and subbranch intersections; duct collar tap-ins; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Do not change the layout or configuration of the duct system except as specifically approved in writing. Accompany requests for modifications with calculations showing that the proposed design will provide the original design results without increasing the system total pressure.

1.6 SUBMITTALS

A. Shop drawings:

1. Schedule of duct systems with applicable pressure classes and leakage classes.
2. Fabrication, assembly, and installation for each duct system: Indicate duct dimensions, sheet metal thickness, reinforcement spacing, and seam and joint construction; and components and attachments to other work.
3. Calculations when required as specified in the article “System Performance Requirements” above.
4. Include layout drawings for the entire ductwork system, drawn at the same scale as the contract drawings, except no smaller than 0.125 inch equals one foot.
5. Schedule of sealing methods for each type of seam and joint.

B. Product data:

1. Acoustical duct lining, adhesive, and sealants.
2. Hangers and supports.
3. Manufactured ducts and fittings.
5. Manufacturer’s installation instructions.

C. Test reports: Air Duct Leakage Test Summary: Submit data on forms as indicated in the SMACNA HVAC Duct Leakage Test Manual. (See sample form at end of section.)

1.7 QUALITY ASSURANCE

A. Specified and scheduled duct construction exceeds SMACNA requirements. Comply with specifications and schedules, and for materials or methods not specified or scheduled, comply with SMACNA HVAC DCS and RIDCS.

B. Comply with NFPA 90A and 90B.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or noted products, or comparable product by one of the following:

1. Manufactured ducts and fittings:
   a. Eastern Sheet Metal
   b. Hamlin Sheet Metal
   c. LaPine Metal Products
   d. Linx Industries
   e. McGill Airflow Corp.
   f. MKT Metal Manufacturing
   g. Phoenix Metals
   h. Semco Mfg. Inc.
   i. SPIRAmir

2. Manufactured joint connectors:
   a. Ductmate Industries
b. C.L. Ward & Family Inc.

B. Special use ducts and fittings: Scheduled manufacturers and named products are intended to set a standard for materials, quality of construction, and performance.

2.2 MATERIALS


B. Carbon steel sheets: Cold-rolled, ASTM A 366/A 366M, commercial quality, oiled matte finish.

C. Aluminum sheets: ASTM B 209, alloy 3003, temper H14.

   1. Ducts exposed to view: Standard one-side bright finish.
   2. Concealed ducts: Mill finish.

D. Reinforcement shapes and plates: Galvanized steel where installed on galvanized sheet steel ducts; carbon steel on carbon steel ducts and compatible materials on aluminum and stainless-steel ducts.

E. Tie rods: Galvanized steel, minimum diameter 0.25 inch (6 mm) for ducts up to 36 inches (900 mm); 0.375 inch over 36 inches (900 mm).

F. Vapor barrier: Polyethylene sheet, 6 mils (0.15 mm) thick, conforming to Federal Specification UU-P-147 for permeability.

2.3 JOINT AND SEALING MATERIALS

A. Flexible joint material for connections to vibrating equipment: Specified in Section 23 3300, Duct Accessories.

B. Duct joint and seam sealants: UL classified, fire-resistive, conforming to NFPA 90A and 90B, high pressure type (up to 10 inches (2490 Pa) SMACNA pressure class) equal to the following products:

   1. Indoor application: Hardcast “Iron Grip” (IG-601) brush-on water-based vinyl acrylic sealing mastic.
   2. Outdoor application:

      a. Hardcast “Versa-Grip” (VG-102) brush-on indoor/outdoor water-based polyester/synthetic resin sealant with UV inhibitors.
b. Hardecast “Aluma-Grip” (AFT-701) pressure sensitive sealant on a roll. Two-mil (0.05-mm) aluminum foil backing, peel-off release liner, 33-mil (0.8-mm) modified elastomeric butyl sealant (100 percent solids). To be used outdoors only.


4. Flange gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 FIBERGLASS ACOUSTICAL LINING FOR RECTANGULAR DUCTWORK

A. Fiberglass, ASTM C 1071, Type 1, flexible; meeting requirements of NFPA 90A and 90B, bonded with thermosetting resin.

B. Density: Nominal 2 lbs per cubic ft (32 kg per cubic m).

C. Facing: Black composite sprayed-on surface, recommended by manufacturer to prevent particles from penetrating the fiberglass, and to be cleaned by vacuum or dusting.

D. Resistance to microbial growth: Tested and shown to support no growth of:

1. Fungi in accordance with ASTM G 21.
2. Bacteria in accordance with ASTM G 22.

E. Thickness:

1. Typical: One inch (25 mm) thick, ASTM C 423 (Type A mounting) noise reduction coefficient (NRC) at least 0.60.
2. Where indicated: Two inches (51 mm) thick, ASTM C 423 (Type A mounting) NRC at least 0.95.

F. Adhesive for acoustical lining: Equal to Foster 85-60, non-flammable elastomer adhesive designed for attaching low density duct liner and fibrous glass insulation to sheet metal.

2.5 ROUND DUCTS AND FITTINGS


1. Materials: Galvanized steel or aluminum where indicated.
2. Fittings for branch connections shall be conical type. Centerline radius of elbows shall be 1.5 times the diameter. Duct access door shall be equal to type AR-W.

<table>
<thead>
<tr>
<th>Round Duct Minimum Metal Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duct Element</td>
</tr>
<tr>
<td>Ducts up to 14 inches diameter</td>
</tr>
</tbody>
</table>
B. Single-wall, longitudinal-seam round duct and fittings: Fabricate of galvanized steel according to SMACNA HVAC DCS.
   1. Seam: Flat lock, snap-lock seam not permitted.

2.6 MANUFACTURED SPECIAL FLEXIBLE DUCTS AND FITTINGS

A. Flexible duct laundry dryers: Equal to Universal Metal Hose Company, strip-wound interlocked hose constructed of hot-dipped galvanized carbon steel and leak tight.

2.7 HANGERS AND SUPPORTS

A. Hangers: Galvanized sheet steel, or round, galvanized steel, threaded rod.
   1. Hangers installed in corrosive atmospheres: Electro-galvanized, all-thread rod; or hot-dipped-galvanized rods with threads painted with zinc-rich paint after installation.
   2. Straps and rod sizes: Conform to SMACNA HVAC DCS for sheet steel width and gauge and steel rod diameters.

B. Duct attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.8 FABRICATION

A. Dimensions indicated on drawings are outer dimensions of ducts.

<table>
<thead>
<tr>
<th>Duct Element</th>
<th>Steel Gauge</th>
<th>Aluminum Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ducts up to 24 inches wide</td>
<td>24</td>
<td>0.040</td>
</tr>
<tr>
<td>Ducts 25 to 48 inches wide</td>
<td>22</td>
<td>0.050</td>
</tr>
<tr>
<td>Ducts 49 to 70 inches wide</td>
<td>20</td>
<td>0.064</td>
</tr>
<tr>
<td>Ducts over 70 inches wide</td>
<td>18</td>
<td>0.071</td>
</tr>
<tr>
<td>Fittings up to 36 inch width</td>
<td>20</td>
<td>0.064</td>
</tr>
<tr>
<td>Fittings 36 inch to 50 inch width</td>
<td>18</td>
<td>0.071</td>
</tr>
<tr>
<td>Fittings over 50 inches in width</td>
<td>16</td>
<td>0.090</td>
</tr>
</tbody>
</table>
B. Verify field measurements and resolve conflicts, before beginning to fabricate ductwork, as specified in Part 3 below.

2.9 DUCT CONSTRUCTION

A. Construct ductwork using the Duct Construction Schedule on the drawings. Schedule includes duct system pressure class requirements, minimum sheet metal gauges, leakage allowances, and maximum reinforcement spacing. These requirements exceed the requirements of SMACNA HVAC DCS.

B. Construct ductwork of galvanized steel, except where another material is noted on drawings or specified.

C. Construct gravity duct systems (nonfan-powered), such as pressure relief and transfer, in accordance with SMACNA HVAC DCS minimum one inch pressure class unless otherwise scheduled.

D. Crossbreak or bead ducts of dimensions of 12 inches (305 mm) and over in pressure classes under 2 inches (500 Pa).

E. Plenums, casings, and access doors: Construct in accordance with SMACNA HVAC DCS.

1. Casings and plenums for negative pressures greater than 3 inches wg (747 Pa): Construct in accordance with SMACNA RIDCS.
2. Where casings and plenums are on the suction side of fans, and negative pressure which exceeds their construction class may occur, provide safety relief panels or dampers as indicated on drawings.

F. Joint connections shall be constructed in accordance with SMACNA HVAC DCS, or with a manufactured duct connection system equal to Ductmate Industries “Ductmate,” selected to assure compliance with leakage factors indicated on the drawings. Snap-lock or flat-lock seams are not acceptable.

G. Engineered duct systems using metal gauges or reinforcing less than required in the schedules on the drawings are not acceptable.

H. Where not otherwise specified, scheduled, or detailed, construct ductwork in accordance with SMACNA HVAC DCS.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL
A. Before fabricating ductwork, make field measurements and coordinate layout of ductwork shown on the drawings with building components and work of other trades. Resolve conflicts and obtain written approval for deviations before fabrication.

B. Provide duct systems complete with built-in accessories as specified herein, in other sections of the specifications, as indicated on the drawings, and, where not otherwise indicated, in accordance with SMACNA HVAC DCS.

C. Thoroughly clean duct and duct fittings before they are installed, and keep them clean until the acceptance of the completed work. Use a duct cap cover on all unfinished ends to prevent moisture, dirt particles, dust, and debris from entering the installed ductwork during construction.

3.2 INSTALLING METAL DUCTWORK

A. Provide ductwork shown on drawings and specified herein.

B. Ductwork shall not penetrate rated partitions where fire or smoke dampers are indicated on the drawings. Connect ductwork only after the damper installation is complete and accepted, as specified in Section 23 33 00, Duct Accessories.

C. Connecting duct to louver: Provide angles or damper collars as required. Slope duct down toward louver. Blank off any part of louver not required to be open, with double pan panels constructed of the same material as the connecting duct, 1.5 inches (38 mm) thick and insulated with 1.5 inches (38 mm) of fiberglass insulation. Seal connection.

D. Install metal ductwork neat in appearance. Interior surfaces shall be smooth and free of obstructions. Duct lines shall be true and smooth. Where ducts pass through openings in partitions, ceilings and floors, fit them with trim angles to close joint between duct and construction.

E. Support ductwork on metal straps or rods in accordance with SMACNA HVAC DCS and as specified. Comply with manufacturers’ load ratings and application data for each type of support and fastener.

1. Connections to substrate:
   a. Bar joists: Suspend from top chord or panel points.
   b. Concrete: Inserts or fasteners specified in Section, Hangers, Supports, and Anchors. Install inserts before placing concrete.
   c. Precast concrete planks: Toggle bolts.
   d. Structural steel: Beam clamps.
   e. Do not support ductwork from gypsum roof deck supports or metal deck.
2. Ducts 54 inches (1372 mm) wide and under: Strap hangers shall extend down sides of ducts and attach to underside with at least two sheet metal screws per strap. Straps shall be made of the same metal as the ducts they are attached to.

3. Ducts over 54 inches (1372 mm) wide: Support on trapeze hangers formed of structural angle irons and hanger rods in accordance with SMACNA HVAC DCS.

4. Round ducts: Support on rods or galvanized straps, and bands, as shown in SMACNA HVAC DCS and in accordance with manufacturer’s recommendations.

5. Support horizontal ducts within 2 feet (610 mm) of each elbow and within 4 feet (1220 mm) of each intersection, in addition to spacing required by SMACNA.

6. Support vertical ducts at a maximum interval of 16 feet (4.9 m) and at each floor.

F. Except in systems with minimum velocity standards, contractor has the option to eliminate reducing transitions and extend ductwork full size, providing space is available and conflict with work of other trades does not occur.

G. Provide for and install in ductwork all automatic control systems dampers, thermometers, coils, sound attenuators, duct accessories and similar equipment furnished under this or other sections of the specifications. Where ATC dampers and other accessories with frames are mounted in ductwork, the ducts shall connect to frames in a manner to provide 100 percent free area for air passage. Seal duct connections to frames with gaskets or duct sealant. Secure connections with pop rivets or sheet metal screws spaced no more than 3 inches (75 mm) on centers around both sides of entire frame. Provide angle iron or channel frames as required for mounting ATC dampers and manual dampers over weatherproof louvers for air intakes and exhaust.

H. Generally, it is intended that all horizontal ductwork be a minimum of 10 inches (255 mm) above suspended ceiling (where applicable) to allow for removal of ceiling panels and ceiling-mounted light fixtures and devices.

I. Large ductwork in mechanical equipment rooms, such as outdoor air, return air, and exhaust air duct connections to fans, air handling units, plenums, and appurtenances, shall be sufficiently braced with angle irons to prevent vibration and duct damage, and to reduce noise level.

J. Assemble round ducts and fittings using duct sealant and sheet metal screws as recommended by the manufacturer.

K. Flashing of ducts through outside walls shall be as detailed on the drawings.

L. Where noted on the drawings provide sheet metal drain troughs under piping.

3.3 INSTALLING ROUND DUCT

A. Single-wall: Single-wall, spiral duct and fittings.
1. Exception: Single-wall, longitudinal-seam duct is permitted where concealed, in systems of 2 inches wg pressure class or less, for connections to individual air outlets.

3.4 SEALING DUCTWORK

A. Seal all longitudinal and transverse joints, seams, and connections. Sealant may be omitted from welded joints and seams provided duct leakage is within the required tolerance. Sealant may be omitted from locking-type joints and seams (other than snap-lock and button-lock) ductwork with a pressure class below 2 inches of water column (500 Pa) where permitted by code requirements and provided duct leakage is within the required tolerance.

B. Ducts shall be sealed so that they meet leakage factors scheduled on the drawings.

C. Prior to sealing, ductwork shall be clean and dry, free of oil or grease.

D. Apply sealant in accordance with the manufacturer’s recommendations.

E. Product application:
   1. Galvanized steel: Brush-on or pressure sensitive sealant, as applicable.
   3. Stainless steel: Not applicable.

F. Allow time for sealant to dry or cure, in accordance with manufacturer’s recommendations, before leak testing.

3.5 INSTALLING LAUNDRY DRYER DUCTWORK

A. Connect to dryer with flexible duct specified for drying applications.

B. Provide dryer vent cap at exterior wall where indicated on the drawings.

3.6 IDENTIFICATION

A. Mark ductwork in accordance with requirements for identification specified in Section 23 05 00, Common Work Results for HVAC.

3.7 AIR DUCT LEAKAGE TESTS

A. Leakage test procedures shall be in accordance with SMACNA Leakage Test Manual.

B. After installation and prior to insulating, test the ductwork for air leakage. Ducts to be tested, test pressures, and leakage factors (maximum volume of leakage per 100 sq ft (9.3 sq m) of duct surface area) shall be as scheduled on the drawings.
C. Conduct tests before any equipment is connected that would be subject to damage from the test pressure. Provide temporary blank-offs or caps.

D. Notify parties whose presence is necessary for the test; and in all cases, the Architect and testing and balancing subcontractor at least two normal work days prior to the actual test.

E. While system is under test pressure, survey joints for audible leaks. Mark leakage points, shut down blower, and make repairs. Retest after duct sealant has dried or cured.

F. If test duct sections exceed the allotted leakage levels, locate sources of leakage, make repairs and repeat test procedures until acceptable leakage levels are demonstrated.

G. During the installation, continuously examine ductwork to ascertain that it is sealed properly.

3.8 CLEANING DUCT SURFACES

A. Where ducts will be exposed and therefore required to be painted, remove labels used for construction and clean surfaces ready for painting.

END OF SECTION
Leakage test form follows Section.
### AIR DUCT LEAKAGE TEST SUMMARY

**AIR SYSTEM** _______________________________  **LEAKAGE CLASS (G_L)** _________
**FAN CFM (Q)** ______________________________  **SPECIFIED TEST PRESSURE (P_t)** ________

**DUCT CONSTRUCTION PRESSURE CLASS (P_c)** ________

<table>
<thead>
<tr>
<th>SUBJECT DUCT</th>
<th>SURFACE AREA IN FT²</th>
<th>FACTOR CFM/100 FT²</th>
<th>CFM (TEST SECTION)</th>
<th>DIAMETER ORIFICE</th>
<th>PRESSURE “W.G.” ACROSS ORIFICE</th>
<th>DATE</th>
<th>PERFORMED BY</th>
<th>WITNESSED BY</th>
<th>ACTUAL CFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEST SECTION(S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Not For Bidding

---

SMACNA HVAC Air Duct Leakage Test Manual-1st Ed.
SECTION 23 33 00 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flexible joint fabric.
B. Bird screen.
C. Air turning vanes.
D. Spin-in fittings.
E. Duct access doors.
F. Dampers.
G. Duct clamps.

1.2 RELATED SECTIONS

A. Access doors: Division 08.
B. Louvers and vents: Division 08.
C. Duct-mounted smoke detectors: Section 28 31 00.
D. Diffusers, registers, and grilles: Section 23 37 13.
E. Damper actuators: Automatic temperature control sections.

1.3 REFERENCES

A. AMCA 210: Laboratory Methods of Testing Fans for Rating.
D. NFPA 90A: Installation of Air Conditioning and Ventilating System.
E. NFPA 90B: Installation of Warm Air Heating and Air-Conditioning Systems.
F. NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

G. SMACNA HVAC DCS: HVAC Duct Construction Standards, Metal and Flexible.

1.4 SUBMITTALS

A. Product data: Each type of duct accessory included in the project.
   1. Include manufacturer's written installation instructions for each type of fire damper, combination fire/smoke damper, and smoke damper.

B. Shop drawings: Detail equipment assemblies and indicate dimensions, loadings, required clearances, method of field assembly, components, locations, and size of each field connection. Detail these accessories:
   1. Special fittings and manual and automatic volume damper installations.
   2. Fire, combination fire/smoke, and smoke damper installations, including sleeves and duct access doors.

C. Certifications: Certified test data for dynamic insertion loss; sound power levels; airflow performance data, and static pressure loss.

1.5 QUALITY ASSURANCE

A. Work of this section shall comply with NFPA 90A and 90B, and SMACNA HVAC DCS.

1.6 EXTRA MATERIALS

A. Provide one spare link for every four fire dampers installed in the project, with a minimum of two of each type.

B. Deliver and store spare links in the cabinet for spare automatic sprinklers, or as directed by the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers' names and specific products are described in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by other named manufacturers.
2.2 FLEXIBLE CONNECTIONS


1. For use indoors: Equal to Ventfabrics "Ventglas," coated with polychloroprene (DuPont "Neoprene"), 30 ounces per square yard (850 g per 0.8 square meter).
2. For use outdoors: Equal to Ventfabrics "Ventlon," coated with DuPont weather-, sunlight- and ozone-resistant "Hypalon," 26 ounces per square yard (732 g per 0.8 square meter).

2.3 SCREENS

A. Bird screen: ASTM E 2016, general industrial-use wire cloth, Grade C, medium light or heavier, nominal 0.5-inch (13-mm) mesh and 0.063 inch (1.6-mm) wire diameter, aluminum or stainless steel.

1. Frame: Removable, rewirable, of same material and finish as the duct or accessory to which it is installed.

2.4 MANUFACTURED UNITS

A. Volume extractors: Equal to Hart & Cooley "Vectrol" Type AVLR, with the equal to Young Regulator Co. No. 429 FD end bearing and No. 443-B 3/8-inch operator; or Type VLK, with worm-driven mechanism accessible through face of diffuser or grille with an 18-inch-long removable key operator.

B. Air turning vanes: Double vane type, constructed in accordance with SMACNA HVAC DCS, from the same material as the duct.

C. Spin-in fittings in accordance with SMACNA HVAC DCS are acceptable for a round take-off connection from a rectangular duct, provided they meet the duct pressure classification.

2.5 DUCT ACCESS DOORS


B. Construction: Door and frame fabricated of 24 gauge galvanized steel, minimum size 16 inches (406 mm) by 16 inches (406 mm), or 16 inches (406 mm) by maximum duct size.
C. Door: Hinged with continuous piano hinge; number of cam latches to suit door size. Insulated doors shall be double pan construction, one inch (25 mm) thick with one inch (25 mm) thick minimum 3.5 pound (56 kg per cubic meter) density fiberglass insulation cut full to require forcing into the pan.

D. Gaskets: Continuous around perimeter, sealing frame to duct and door to frame, neoprene or foam rubber.

E. As an option, provide round access doors equal to Ventfabrics "Ventlok Twist-In" doors, complete with safety holding cable, 12 inches (305 mm) diameter.

2.6 DAMPERS

A. Material

1. Where aluminum duct is required by the specifications, dampers shall be all aluminum construction in lieu of galvanized steel.

B. Manual volume dampers:

1. 13 inches (330 mm) and larger in height: Balanced multi-louver, opposed-blade type with maximum blade width of 8 inches (205 mm), equal to Ruskin Model MD 35 with corrosion resistant, molded synthetic sleeve type bearing and 0.375-inch (9.5-mm) square control shaft; and with Young Regulator Co. Model No. 443B-3/8 damper regulators designed with 2-inch high base for mounting on externally insulated duct.

2. 12 inches (305 mm) or less in height: Fabricated from 16 gauge metal with hemmed edges, 0.375-inch (9.5-mm) square rod, Young Regulator Co. Model No. 443B-3/8 regulator designed with 2-inch high base for mounting on externally insulated duct and Model No. 429 FD end bearing.

3. Provide locking regulators.

C. Remote cable operated damper control.

1. Concealed ceiling type control: Remote damper controller with access through a 2.5-inch hole in the ceiling concealed with a cover plate, equal to Young Regulator. Finish on cover plate to be selected by Architect. Control system shall provide up to 35 inch-pounds of push/pull torque:

   a. Controller: 14-gauge galvanized-steel rack and pinion controller with positive lock graduations.
   b. Cable: Tensile strength of 265,000 pounds:

      (1) Inner wire: Type 302 stainless-steel wire 0.054 inches in diameter, comply with AMS 5688 J and ASTM-313-98.
(2) Outer wire: 3/16 galvanized steel.

c. Mounting cup and cover plate: 301 zinc cup mounted to ceiling framing member with 3-inch zinc plated cover to be held in by 3/4-inch stainless-steel screws.
d. Damper cable control: Provide external-mounted damper controller with cable and adjustable lever arm operation, suitable for commercial grade damper.

D. Counterbalanced backdraft dampers: Equal to Ruskin Type CBS7 fabricated with galvanized steel channel frame. Blades shall be 16 gauge minimum galvanized steel with neoprene blade seals and neoprene jamb seals, maximum width 7 inches (178 mm), mounted on a steel shaft with ball bearings. Field adjustable counterbalance. Frame shall have a rust-inhibitive coating applied at the factory.

2.7 DUCT CLAMPS

A. Duct clamps for flexible duct and flexible fabric connections: Positive locking drawbands able to conform to any shape. Fabricate from a single piece of stainless steel, with hex screw and worm gear.

B. Nonmetallic duct clamps for flexible duct connections: Heavy-duty adjustable nylon strap type, equal to products of HellermannTyton Corporation, for 12-inch (305-mm) diameter and smaller flexible ductwork, complying with UL 181.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Duct accessories shall be mounted or installed properly in accordance with the manufacturer's instructions and as indicated on the drawings.

3.2 INSTALLING FLEXIBLE CONNECTIONS

A. Flexible connections: Install using flexible joint fabric where duct connects to motor-driven equipment, and in other locations shown on drawings. Securely clamp flexible connection to duct and collar with duct clamps, providing 1 inch (25 mm) slack. Stitch seams with fiberglass thread.

1. Nonmetallic clamps: Install in accordance with manufacturer’s recommendations, using manufacturer's special tools.
2. Flexible connections are not required where duct connects to air-handling equipment with internally isolated fans.

3.3 INSTALLING SCREENS

A. Install bird screen in outdoor air and exhaust air connections.
B. Install bird screen at open ended duct terminations and where indicated on mechanical drawings.

3.4 INSTALLING MANUFACTURED UNITS

A. Install necessary devices to balance the air flow to produce air quantities at outlets as indicated on the drawings.

B. Install turning vanes in 90-degree square elbows.

C. Install spin-in fittings as indicated on the drawings. Mechanically fasten to duct main with screws or rivets.

3.5 INSTALLING DUCT ACCESS DOORS

A. Install duct access doors in ductwork for access to fire dampers, combination fire/smoke dampers, smoke dampers, ATC dampers, duct coils, control devices, and any other devices, equipment, or components requiring maintenance, service, or adjustment and located inside ducts or adjacent equipment.

B. Provide OSHA-approved labels on doors enclosing fire protection devices. Labels shall have lettering at least 1/2 inch (13 mm) high describing the protection device enclosed.

3.6 INSTALLING DAMPERS

A. Install dampers at locations indicated on drawings and where required to properly balance the systems and to deliver the air quantities indicated. Each damper shall have substantial operators of proper size with locking facilities.

3.7 INSTALLING CONTROL DAMPERS

A. Install control dampers per manufacturer’s recommendations.

B. Coordinate location of damper operator to provide clear service access for operator.

C. After damper installation is complete and required ductwork connected, test operation of damper to see that damper operates freely and properly and closes tight. Make adjustments if required.

END OF SECTION
SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exhaust, circulating, and supply fans.
B. Accessories.

1.2 RELATED SECTIONS

A. Curbs:  Section 23 05 06.
B. Vibration control supports:  Section 23 05 48.
C. Variable frequency drives:  Section 26 29 23.
D. Motors:  Section 23 05 13.
E. Controls:  Sections 23 09 01 through 23 09 23.

1.3 SUBMITTALS

A. Shop drawings detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

   1. Reports of specified factory tests.

B. Product data:  Include rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:

   1. Certified fan performance curves with system operating conditions indicated. Include static pressure, brake horsepower, and static efficiency plotted against air volume.
   2. Certified fan sound power ratings.
   3. Motor ratings and electrical characteristics, and motor and electrical accessories.
   4. Material gauges and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.

C. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed and field-installed wiring.

D. Maintenance data as required in Division 01 and Section 23 01 01.
E. Submit product data which verifies compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.

1.4 QUALITY ASSURANCE

A. Fans shall be tested and rated in accordance with the applicable AMCA Standard Test Code and Certified Rating Program and bear AMCA Certified Air Rating Seal.

B. Fan selections shall be made to the right of the peak static pressure point, but not on any “flat” portion of the fan curve. Generally, fan selection shall be in the 50 percent to 80 percent range of wide open volume.

C. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

D. UL label and local testing (if required): Section 23 05 00, Common Work Results for HVAC.

1.5 COORDINATION

A. Coordinate the installation of roof curbs, supports, and roof penetrations. Fan installation shall not reduce weathertightness of roof nor violate roof warranty.

B. Coordinate colors selected for roof-mounted fans with colors of other roof-mounted equipment.

1.6 EXTRA MATERIALS

A. Provide adjustments in drives and sheaves and belts as required at time of system balancing to obtain the airflow and static pressure indicated on drawings.

PART 2 - PRODUCTS

2.1 FANS, GENERAL

A. Fan size, capacity, class, arrangement, accessories and discharge shall be as scheduled on the drawings.

B. Motors shall meet the requirements of Section 23 05 13, Common Motor Requirements for HVAC Equipment, including power factor and efficiency.

C. The variable frequency controller shall be a variable frequency drive (VFD) as specified in Section 26 29 23, Variable Frequency Drives. Coordinate to ensure the fan wheel is balanced at all operating speeds. Ensure that unit is free of surge or vibrations due to harmonic frequencies.
D. Fans shall have self-aligning, ball-type bearings designed for thrust load, and grease fittings shall be accessible for relubrication. Fans shall be statically and dynamically balanced.

2.2 EXHAUST, CIRCULATING, AND SUPPLY FANS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled product or comparable product by one of the following:

1. Aerovent, a Twin City Fan Company
2. Acme Engineering and Manufacturing
5. Loren Cook, Inc.
6. Penn Barry.
7. Twin City Fans and Blowers.

B. Roof upblast centrifugal ventilator: Fan wheels shall be of the centrifugal backward-inclined non-overloading airfoil design, direct or belt drive as scheduled. Fan wheel and fan housing shall be of all-aluminum upblast construction, with motor and drive assembly located out of exhaust airstream in separate compartment that is forced-air-cooled with outdoor air. Exposed fasteners shall be stainless steel. Fan shaft and hub shall be zinc-phosphate coated.

C. In-line fan (square): Fan housings, fan wheel and other parts used in the fabrication of the units shall be aluminum or steel of design and gauge standard with the manufacturer. Belt-driven units shall have the motor externally mounted with adjustable motor sheave and base. Lubricating tubes shall be provided from the shaft bearings to the housing. Units shall have support brackets for mountings as shown on drawings. Impeller shall be airfoil blades welded to the hub and have non-overloading characteristics. Wheel shall be statically and dynamically balanced. Wheels shall be backward-inclined, non-overloading, with aluminum blades. Inlet cones shall be provided. Directly driven units shall have motors out of air stream and shall be prewired to an external twist-lock receptacle.

2.3 ACCESSORIES

A. Bird screens: Specified in Section 23 33 00, Duct Accessories.

B. A disconnecting switch without overload protection shall be included under the weather hood of roof-mounted units, completely factory-wired to motor and mounted independently of the motor. Motors for directly driven units shall be provided with solid-state variable speed control connected downstream on the load side of the disconnecting switch, unless otherwise indicated on the drawings.
C. Provide each unit with self-operating aluminum backdraft damper and frame unless indicated otherwise on the drawings. Damper blades shall operate in unison and shall be counterbalanced or otherwise provided with facilities to positively open under fan suction and to close tight when subject to backdraft.

D. Identification: Each fan shall be identified with a fan number no less than 0.5 inch high, as shown in the fan schedule, on an aluminum strip riveted to hood of roof fans and on the motor side of frame for wall fans.

E. Roof-mounted units shall be factory primed and finished with manufacturer’s standard exterior finish, color to match other roof-mounted equipment.

PART 3 - EXECUTION

3.1 INSTALLATION, EXHAUST, CIRCULATING, AND SUPPLY FANS

A. Fans shall be installed in compliance with the manufacturer’s recommendations. Ventilating and ceiling exhaust fans shall be supported from the building structure, not attached to the ceiling suspension members or discharge grille system.

B. Roof fans shall be attached to side of roof curbs using 3/16-inch (4.8-mm) cadmium-plated bolts and nuts or screws, as required, on a maximum of 8-inch (205-mm) centers and a minimum of 8 bolts or screws per fan unit. Use 1-inch minimum diameter aluminum washers with stainless-steel lockwashers under bolt or screw heads.

C. Coordinate with air balancing and provide adjustments, sheaves, and belts as required in Part 1 above to obtain the airflow and static pressure indicated on the drawings.

3.2 ACCESSORIES

A. Fans without supply duct on fan inlet shall be provided with bird screens.

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

B. Provide at least 8 hours of additional instruction time for the equipment specified in this section, consisting of 1 period of 8 consecutive hours, during a period of not more than 60 days.

END OF SECTION
SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

   A. Single-duct variable-air-volume (VAV) terminal units.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

   A. Room thermostat, installed as specified in Section 23 09 13, Instrumentation and Control Devices for HVAC.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

   A. The terminal unit manufacturer shall install controllers and damper actuators furnished as specified in Section 23 0901, Automatic Temperature Control System.

   B. Provide the automatic temperature control subcontractor with a description of the terminal units and requirements for coordinating with control system.

   C. Provide wiring, tubing, and hardware components necessary to produce complete operational units, including transformer, fan relay, inlet airflow pickup, and access to controls.

1.4 RELATED SECTIONS

   A. Controls: Sections 23 09 01 through 23 09 23.

   B. Balancing: Section 23 05 93.

1.5 REFERENCES

   A. UL 181: Factory-made Air Ducts and Air Connectors.


   C. NFPA 90B: Warm Air Heating and Air Conditioning Systems.

   D. ARI 880: Air Terminals.
1.6 PERFORMANCE REQUIREMENTS

A. Coordinate controls with the control manufacturer to affect specified unit performances and unit operation as required by the control sequences.

B. Coordinate with and assist balancing agency to perform tests specified in section, Testing and Balancing.

1.7 SUBMITTALS

A. Product data: Each type of terminal unit and each component.

B. Shop drawings:

1. Show complete dimensions of complete assembled unit with accessories.
2. Include schedule of units, showing performance data for each unit.
3. Include unattenuated (raw) sound power levels for each size unit, at specified rating conditions, for both radiated and discharge sound. Submit sound data with no corrections or noise reduction factors applied, at the airflow rates indicated on schedules at end of section.

C. Certifications: Factory certification that sound data required in “Shop Drawings” above have no corrections or noise reduction factors applied; or, if data do include such factors, guaranteeing that the equipment will meet the scheduled sound level requirements.

1.8 QUALITY ASSURANCE

A. Terminal units shall be certified and listed in the current ARI Directory of Certified Applied Air-Conditioning Products. Listed sound power levels shall show that units meet requirements scheduled at the end of this section.

B. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Scheduled units are the basis for design of the project. The following listed manufacturers also provide units of acceptable quality. If units by any of these manufacturers should be proposed, verify that they meet requirements specified in Division 01 and the article “Product Options” in Section 23 01 01, and submit product data and shop drawings as specified in the article “Submittals” above.

B. Single-duct units:
2. Krueger.
3. Metalaire.
5. Price Company.
7. Trane Company.

C. Drawings show duct and pipe connections, and size and arrangement of unit, based on configuration of design basis unit. Do not propose another manufacturer’s unit, which cannot be made to fit in the space shown. Revise duct and pipe connections and other conditions as necessary to make another manufacturer’s unit meet the project requirements, without addition to the Contract Sum.

2.2 MATERIALS

A. Sheet metal: Galvanized steel.

B. Insulation: Fiberglass, meeting requirements of UL 181 and NFPA 90A and 90B, rated for 4000 fpm air velocity.

1. Thickness: Manufacturer’s standard thickness, to achieve thermal resistance no less than R value of 4.
2. Facing: Manufacturer’s standard acrylic matte coating.

2.3 AIR TERMINAL UNITS, GENERAL

A. Terminal units shall be pressure-independent, each a complete factory-assembled unit, including automatic controls and the features specified or scheduled on the drawings.

B. Provide units of the types, sizes, and capacities scheduled on the drawings.

C. Sound power levels: ARI 880, certified and listed in ARI Applied Products Directory, and not exceeding the levels scheduled at the end of this section.

D. Casing: Not less than 22 gauge steel; airtight, leakage no more than two percent at 3.0 inches wg (747 Pa).

1. Lining: Insulation, cut edges exposed to airstream finished and sealed with facing material.
2. Internal access: Removable bottom panel for access to components requiring service, adjustment, or maintenance; with airtight seal.
E. Duct connections: Round or oval duct collar for primary air connection and a single rectangular flanged connection for discharge.

F. Wiring: Completely factory-wired, UL tested and listed as a complete assembly, with a single-point power connection and single-point control connection. Include control transformers and a power disconnect switch.

G. Air control valve (damper): Constructed of minimum 22-gauge steel, bolted or welded to a continuous shaft which rotates in self-lubricating Delrin or bronze oilite bearings, closing against a closed-cell gasket. Units with multiple blades shall be in the opposed-blade configuration. Blade(s) shall not deflect at inlet pressures up to 6 inches wg. Maximum leakage shall not exceed 2 percent of maximum inlet rated airflow at 3 inches wg inlet pressure.

H. Averaging velocity sensor: Mount in the inlet of the fan terminal. Sensor shall provide a minimum of one air pickup point for each 2.5 inches of inlet diameter (single-point differential sensors are not acceptable). Provide taps for field measuring and balancing.

I. Air control valve (damper) actuator: Type required by the packaged electronic control system, capable of operating air control valve under system air pressures.

J. Controller: Shall maintain airflow setpoint within five percent regardless of system pressure change (airflow-limiting devices are not acceptable).
   1. Capable of field adjustment of minimum and maximum airflow settings without the use of tools.
   2. Constantly monitors space thermostat input, and terminal unit inlet pressure, through the averaging velocity sensor, to maintain space temperature setpoint.
   3. Label: Flow curve for field balancing, affixed to casing.
   4. Provide factory-set maximum and minimum airflows scheduled on the drawings.
   5. Controller shall maintain pressure independence to as low as 0.03 inch wg pressure differential.

K. Heating water coil: Aluminum fins bonded to copper tube by mechanical expansion, tested at no less than 300 psig (2068 kPa), performance scheduled on the drawings, removable for maintenance.

2.4 SINGLE-DUCT VAV TERMINAL UNITS

A. Terminal units as specified above, with heating water coil.

B. Controls: Include a fail-in-place primary air-control valve (damper) with actuator, controller, thermostat and devices necessary to accomplish the control sequence.

C. Control sequence: As shown on the drawings.
2.5 SOURCES QUALITY CONTROL

A. Factory test units to assure that they operate in accordance with the sequence specified.

B. Factory calibrate and adjust controls. Pre-set minimum and maximum airflow setpoints to the values scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install terminals as recommended by the manufacturer and as detailed on the drawings, suspended from overhead structure. Support terminals independently of ductwork.

B. Install units so that access doors or panels can be opened or removed conveniently.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

B. Provide at least 8 hours of additional instruction time for the systems and equipment specified in this section, consisting of 1 period of 8 consecutive hours.

3.3 SCHEDULES

A. Terminals shall not exceed the scheduled sound power levels at the scheduled air flow rates when tested in accordance with ARI 880.

<table>
<thead>
<tr>
<th>Nominal Inlet Size</th>
<th>Rated Air Flow CFM</th>
<th>Radiated Sound Power Level, dB</th>
<th>Discharge Sound Power Level, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Octave Band Center Frequency, Hz</td>
<td>Octave Band Center Frequency, Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125</td>
<td>250</td>
</tr>
<tr>
<td>4”</td>
<td>150</td>
<td>65</td>
<td>54</td>
</tr>
<tr>
<td>5”</td>
<td>250</td>
<td>63</td>
<td>53</td>
</tr>
<tr>
<td>6”</td>
<td>400</td>
<td>66</td>
<td>63</td>
</tr>
<tr>
<td>8”</td>
<td>700</td>
<td>67</td>
<td>57</td>
</tr>
<tr>
<td>10”</td>
<td>1100</td>
<td>72</td>
<td>57</td>
</tr>
<tr>
<td>12”</td>
<td>1600</td>
<td>71</td>
<td>62</td>
</tr>
<tr>
<td>14”</td>
<td>2100</td>
<td>77</td>
<td>61</td>
</tr>
</tbody>
</table>

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

   A. Ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 RELATED SECTIONS

   A. Louvers: Division 08.

   B. Automatic control dampers: Section 23 09 07.

   C. Balancing: Section 23 05 93.

1.3 REFERENCES


1.4 SUBMITTALS

   A. Product data: Each type of diffuser, register and damper, and grille, including frames and accessories, and performance data.

   B. Shop drawings:

      1. Schedule, including size, location, function, and finish of each diffuser, register, and grille.

      2. For each air control device, provide information required to balance the system. Include the factor for each size and type of device for converting velocity to volume.

         a. Include this information in Operating and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

   A. Grilles, registers and diffusers:

      1. Hart and Cooley Inc.
      2. Krueger.
      3. Metalaire.
5. Price Company.
6. Titus Products.

B. Laminar flow supply diffusers:

1. Kruger.
2. Price Company.
3. Titus Products.

2.2 DIFFUSERS, REGISTERS, AND GRILLES

A. Devices of one of the named manufacturers, with performance data, characteristics, features, and accessories of the model or type specified or indicated on the drawings. Model numbers specified below are Krueger except as noted otherwise.

B. See architectural drawings for type of walls and ceilings where diffusers, grilles, and registers are required. Coordinate margin and frame of each device with the substrate in which it will be installed. Where devices are installed in suspended ceilings, assure that they will fit correctly in the type of suspension supports shown or specified.

C. Materials and finish:

1. Construction:
   a. Steel where mounted in ceilings.
   b. Either aluminum or steel where mounted in walls near ceiling.
   c. Heavy-duty steel where mounted in walls near floor.
   d. Welded or mechanically fastened cores in diffusers located in gymnasium.

2. Aluminum devices shall be all aluminum construction, including dampers, where specifications call for aluminum or stainless-steel ductwork.
3. Finish: Manufacturer’s standard white enamel, suitable for final finish or for field painting, unless indicated otherwise.

D. Where narrow margin grilles and registers are specified or indicated on the drawings, they shall be provided with mounting frames except where mounted on ductwork.

2.3 SUPPLY DIFFUSERS

A. Throw length is based on performance data of the scheduled or specified manufacturer and model. Select units of other manufacturers whose performance data meet the required conditions. Throw direction of square and rectangular ceiling diffusers shall be four-way unless otherwise indicated on the drawings.
B. Square and rectangular ceiling diffusers: Series SH with square, rectangular, or round neck and removable core. Each unit shall have a straightening grid. The grids shall be set at right angles to one another.

1. Frame Style 23 (panel diffuser): Diffusers mounted in nominal 24 by 24-inch (600 by 600-mm) or 24 by 48-inch (600 by 1200-mm) flat steel panels as indicated on the drawings, to lay into suspended ceiling grid of acoustical ceilings.

2. Frame Style 22 (surface mount): Diffuser with flat frame to mount at underside of plaster or gypsum wallboard ceilings.

C. Laminar flow supply diffusers: Equal to Price LFD Series. Constructed of aluminum with a white baked enamel finish, round duct inlet with combination damper and grid. Perforated and flush face style with quick-release fasteners and surface mounting. Face size is 24 by 24 inches (600 by 600 mm) or 24 by 48 inches (600 by 1200 mm).

2.4 SUPPLY GRILLES AND REGISTERS

A. For registers, provide opposed-blade dampers with linkage and adjustment through grille face with a screwdriver or allen wrench. For plaster wall or ceiling construction, provide with plaster frames.

B. Wall-mounted near ceiling: Grilles 5880H (aluminum); registers 5880H (aluminum); double deflection with horizontal face bars, minimum 1.25-inch (32-mm) overlap margin.

C. Ceiling-mounted: Register 5180-OBD (aluminum), individually adjustable curved air deflection blades, 1-, 2-, 3-, or 4-way air pattern as indicated on the drawings, minimum 1.25-inch (32-mm) overlap margin.

1. Provide alignment tabs in frame where multiple units are joined and mitered corners at 90 degree turns.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

A. For registers, provide opposed-blade dampers with linkage and adjustment through grille face with a screwdriver or allen wrench. For plaster wall or ceiling construction, provide with plaster frames.

B. Ceiling-mounted and wall-mounted near ceiling: Grille S-580H (aluminum), Register S-580H (aluminum). Fixed horizontal face bars set at 35 to 45 degrees deflection, minimum 1.25-inch (32-mm) margin.

C. Square and rectangular ceiling diffusers used for return or exhaust: Same as specified above for diffuser.
PART 3 - EXECUTION

3.1 INSTALLING GRILLES, REGISTERS AND DIFFUSERS

A. Securely attach grilles, registers, and diffusers in place. Do not install the grilles and registers until duct interiors have been painted as specified in Section 23 05 00, Common Work Results for HVAC.

B. Install all air control devices complete with the accessories specified, securely attached in position. Make operating devices accessible.

C. Adjust diffuser straightening grids to provide uniform air distribution above diffuser face.

D. Adjust supply register deflectors to provide uniform air distribution to the areas served.

END OF SECTION
SECTION 23 41 00 - PARTICULATE AIR FILTERATION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide 4 sets of filters for every item of equipment requiring filters, as follows:
   1. One set of filters for regular service, installed before air balancing.
   2. Remaining set of filters for regular service, provided as extra materials for future use.

1.2 RELATED SECTIONS

A. Split system air conditioning units: Section 23 81 26.
B. Ductless split-system units: Section 23 81 27.
C. Unit heaters: Section 23 82 39.

1.3 REFERENCES

A. ASHRAE 52.1: Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices used in General Ventilation for Removing Particulate Matter.
B. ASHRAE 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
C. ARI 850: Commercial and Industrial Air Filter Equipment.

1.4 DEFINITIONS

A. MERV: Minimum Efficiency Reporting Value as determined by ASHRAE 52.2.
B. Temporary service: Operation of equipment during the construction period, before air balancing.
C. Regular Service: Operation of equipment during air balancing and in normal use during occupancy.

1.5 SUBMITTALS

A. Product data:
   1. For filters, include filter ratings, rated flow capacity, and fire classification.
B. Shop drawings: Illustrate assemblies and attachments.

C. Closeout submittals: As required for Operating and Maintenance Manuals in Division 01 and Section 23 01 01, provide a schedule of locations of filters, identifying equipment and filter types and sizes, including prefilters and final filters.

1.6 QUALITY ASSURANCE

A. Provide all filters for regular service from a single manufacturer.

B. Test filters by methods described in ASHRAE 52.1 and ASHRAE 52.2.

C. Comply with ARI 850.

1.7 EXTRA MATERIALS

A. Disposable and throwaway filters: For each filter included for regular service, provide 2 extra filters. Identify each filter with its name and intended location and use.

B. Provide filters and media in protective packaging, with identifying labels or markings.

C. Except as otherwise required in Division 01, deliver to location designated by Owner, and shelve or stack as directed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following:

1. Filters and filter-holding systems:
   a. AAF International.
   b. Airguard; Clarcor Air Filtration Products
   c. Camfil Farr
   d. Flanders Filters, Inc.

2. Filter Gauges:
   a. Dwyer Instruments, Inc.
   b. H.O. Trerice Co.
   c. Miljoco Corporation
   d. Weksler Instruments
2.2 FILTERS, GENERAL

A. Coordinate with approved manufacturers of the various approved air handling units and equipment for filter size and thickness required.

B. Thickness: Generally, large air handling units shall have filters 2 inches and thicker. Smaller units such as fan-coil units may be limited to filters 2 inches thick.

C. Filter face areas: As scheduled, or equivalent to one square foot for each 300 cfm.

2.3 THROWAWAY FILTERS

A. FS F-F-310, Type I throwaway frame and media, Grade B high dust holding capacity, of size and thickness to fit units.

2.4 DISPOSABLE FILTERS, MERV 8

A. Camfil Farr “Farr 30/30”, Class 2, thickness 4, 2, or 1 inch(es), and size required for each location, disposable.

B. Rating in accordance with ASHRAE 52.1:
   1. Average efficiency: 25 to 30 percent.
   2. Average arrestance: 90 to 92 percent.

C. Rating in accordance with ASHRAE 52.2: MERV 8

D. UL 900: Class 2.


F. Medium support grid: Welded wire with an effective open area not less than 96 percent, bonded to medium.

   1. Performance: Medium shall not oscillate nor pull away from support grid.
   2. Design: Tapered radial pleats, supporting medium both vertically and horizontally.

G. Enclosing frame: High-wet-strength beverage board, with diagonal supports bonded to media pleats. Filter pack continuously bonded to inside of frame so that no air leaks around edges.

2.5 DISPOSABLE FILTERS, MERV 13
A. Camfil (Farr) Opti-Pac high-efficiency, mini-pleated, 4-inch deep, disposable type. Each filter assembly shall consist of a high-efficiency filter, medium retainer and holding frame.

B. Medium: Microfine glass media in a close-pleat design bonded into a beverage board holding frame.

C. Rating in accordance with ASHRAE 52.1: Average efficiency 80-85 percent, and average arrestance not less than 98 percent.

D. Rating in accordance with ASHRAE 52.2: MERV 13.

E. The initial resistance to airflow shall not exceed 0.5 inch wg at 500 fpm.

F. UL 900: Class 2.

2.6 FILTER GAUGE

A. Gauge: Equal to Dwyer “Magnehelic”, Series 2000, range zero to 3 inches wg, with divisions of 0.10 inch.

B. Accessory package: To adapt the magnehelic gauge for use as a filter gauge. Package includes aluminum surface-mounting bracket with screws, two 5-foot lengths of 0.25-inch aluminum tubing, two static pressure tips, and two molded plastic vent valves, with integral compression fittings on both tips and valves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Before startup of each item of equipment requiring a filter, install filters for temporary service.

1. Generally, provide throwaway filters for temporary service.
2. On equipment with prefilter and final filter, provide only the specified prefilter for temporary service.

B. Immediately prior to air balancing, remove temporary filters and install filters required for regular service.

3.2 INSTALLING FILTER GAUGE

A. Mount across filter section in accordance with manufacturer’s instructions.

END OF SECTION
SECTION 23 52 16 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes packaged, factory-fabricated and -assembled, gas-fired, water-tube condensing boilers, trim, and accessories for generating hot water.

1.2 SUBMITTALS

A. Product data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. 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.
4. Wiring diagrams: Detail power, signal, and control wiring.

C. Source quality-control test reports.

D. Startup service reports.

E. Operation and maintenance data: For condensing boilers to include in emergency, operation, and maintenance manuals.

F. Certifications:

1. As required in Section 23 01 00 for burner startup and service.

G. Service agreement specified in “Maintenance Service” below, executed to the Owner and notarized.
1.3 QUALITY ASSURANCE

A. Product options: Drawings indicate size, profiles, and dimensional requirements of condensing boilers and are based on the specific system indicated. Refer to Division 01 Section “Product Requirements.”

B. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME compliance: Fabricate and label condensing boilers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. ASHRAE/IESNA 90.1 Compliance: Condensing boilers shall have minimum efficiency according to Table 10-8.

E. UL compliance: Test condensing boilers to comply with UL 795, “Commercial-Industrial Gas Heating Equipment.”

F. Flue gas composition and temperature shall meet the requirements specified in Section 23 01 00, Operation and Maintenance of HVAC.

G. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

H. Gas regulators shall have emergency exposure rating of 15 psi. Regulator shall not suffer internal damage at this overpressure.

1.4 REGULATORY REQUIREMENTS

A. Before construction begins, obtain and complete forms, and apply for the permit and registration of the burners and boilers with the authority having jurisdiction.

B. Components and installation, including sequences of operation, shall comply with the applicable requirements of ASME CSD-1, Controls and Safety Devices for Automatically Fired Boilers.

C. Costs of complying with these and other applicable regulatory requirements shall be included in the Contract sum.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
1.6 MAINTENANCE SERVICE

A. In addition to the startup service specified in Section 23 01 00, the qualified service and maintenance organization shall provide a 5-year service agreement covering all parts and labor for regular service, emergencies, and repairs.

B. Regular service: One visit at annual startup of boilers and a second visit at the end of the heating season.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 WATER-TUBE CONDENSING BOILERS

A. Manufacturers: Harsco Industrial, Patterson-Kelley Mach boiler with Nuro boiler control, or a comparable product by Laars or Riello.

B. Description: Factory-fabricated, -assembled, and -tested water-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only.

C. Water-tube boiler components:

2. Pressure vessel: Carbon steel with welded heads and tube connections.
4. Gas train: Combination gas valve with manual shutoff and pressure regulator. Include 100 percent safety shutoff with electronic flame supervision.
5. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
6. Casing:
   a. Jacket: Sheet metal, with snap-in or interlocking closures.
   b. Control compartment enclosures: NEMA 250, Type 1A.
   c. Finish: Baked-enamel protective finish.
d. Insulation: Minimum 2-inch- (50-mm-) thick fiberglass insulation surrounding the heat exchanger.

e. Combustion-air connections: Inlet and vent duct collars.

7. Mounting base to secure boiler to concrete base.

2.3 HOT-WATER BOILER TRIM

A. Include devices sized to comply with ANSI B31.9, “Building Services Piping.”

B. Aquastat controllers: Operating, firing rate, and high limit.

C. Safety relief valve: ASME rated. 75 psig (517 kPa).

D. Altitude and temperature gauge: Minimum 3-1/2-inch- (89-mm-) diameter, combination water-pressure and -temperature gauge. Gauges shall have operating-pressure and -temperature ranges so normal operating range is at approximately 50 percent of full range.

E. Boiler air vent: Automatic.


2.4 BURNER OPERATING CONTROLS

A. Description: To maintain safe operating conditions, burner safety controls limit the operation of burner.

1. High cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.

2. Low-water cutoff switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.


4. Alarm bell: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

2.5 BOILER OPERATING CONTROLS

A. Boiler operating controls shall include the following devices and features:

1. Control transformer: 115 V.

2. Sequence of operation: As indicated on the drawings.
2.6 VENTING KITS

A. Kit: ASTM A 959, Type 29-4C, stainless-steel or CPVC, vertical vent terminal, roof passage thimble, indoor wall plate, vent adapter, condensate trap, and sealant.

B. Combustion-air intake: Stainless-steel or CPVC, vertical vent terminal with screen, inlet air coupling, and sealant.

2.7 ACCESSORIES

A. Device plate for emergency boiler switch: As specified in Section 23 05 00, engraved plastic, red letters on white background, reading “EMERGENCY BURNER DISCONNECT.”

B. Circulation pump: Provide as indicated on the drawings.

2.8 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code. Section I, for high-pressure boilers and Section IV, for low-pressure boilers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install boilers level on concrete base. Concrete base is specified in Section 23 05 29.

B. Concrete bases: Anchor boilers to concrete base.
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

5. Cast-in-place concrete materials and placement requirements are specified in Division 03.

C. Vibration isolation: Rubber pads with a minimum static deflection of 0.25 inch (6.35 mm). Vibration isolation devices and installation requirements are specified in Division 23 Section “Vibration Control Supports for HVAC.”

D. Install gas-fired boilers including exhaust/flue venting system according to NFPA 54/ANSI Z223.1 and per the manufacturer’s recommendations.

E. Assemble and install boiler trim.

F. Install electrical devices furnished with boiler but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 23 0508, HVAC Piping Specialties.

C. Connect gas piping full size to boiler gas-train inlet with union.

D. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to nearest floor drain.

F. Connect breeching full size to boiler outlet.

G. Install piping adjacent to boiler to allow service and maintenance.

H. Ground equipment according to Section, 26 05 26, Grounding and Bonding.
I. Connect wiring according to Section 26 05 19, Wires and Cables.

J. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to test, inspect, and adjust boiler components and equipment installation and to perform startup service.

B. Perform installation and startup checks according to manufacturer’s written instructions.

C. Leak test: Hydrostatic test. Repair leaks and retest until no leaks exist.

D. Operational test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Adjust initial temperature set points.

G. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

H. Occupancy adjustments: When requested within 24 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

I. Prepare written report that documents testing procedures and results.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain condensing boilers. Refer to Section 23 05 00.

END OF SECTION
CONDENSING BOILERS

23 52 16 - 8
SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Split-system air-conditioning and heat pump units consisting of separate evaporator-fan (indoor) and compressor-condenser (outdoor) components.

1.2 RELATED SECTIONS

A. Refrigerant piping: Section 23 23 00.
B. Refrigeration service and compressor warranty: Section 23 01 00.
C. Filters: Section 23 41 00.
D. Motors: Section 23 05 13.

1.3 REFERENCES


1.4 DEFINITIONS

A. Compressor-condenser unit: The part of the split system that contains a refrigerant compressor and a coil for condensing refrigerant (evaporator for heating operation in heat pump units).

B. Evaporator-fan unit: The part of the split system that contains a coil for cooling (heat rejection for heating operation in heat pump units) and a fan to circulate air to conditioned space.

1.5 PERFORMANCE REQUIREMENTS

A. Design of the HVAC system, including associated work of other design disciplines and trades, is based on scheduled and specified equipment. If a different item of equipment should be proposed, as permitted under "Acceptable Manufacturers," below, ascertain that it will:

1. Perform to the scheduled and specified capacities.
2. Make no additional demands on other systems such as domestic, heating, and chilled water, or electricity.
3. Meet or exceed the specified requirements.
1.6 SUBMITTALS

A. Product data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model included in the work.

1. Submit product data which verifies compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.
2. Product data shall verify compliance with CEE efficiency requirements.

B. Shop drawings:

1. Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
2. Detail dimensions, clearances, and methods of field assembly, with locations and sizes of field connections.

1.7 QUALITY ASSURANCE

A. Fabricate refrigeration equipment to comply with ASHRAE 15.

B. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

C. Regulatory requirements:

1. ICC: HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.
2. COMAR 14.26.03: Packaged equipment with over 20 tons of cooling capacity shall meet Tier 2 requirements for minimum efficiencies for unitary commercial air conditioners of the Consortium for Energy Efficiency (CEE), in effect on 1 January 2002.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide scheduled products, or comparable product by one of the following:

1. Aaon
2. Annexair
3. Venmar
2.2 SPLIT SYSTEM, GENERAL

A. Motors and power factor correction shall comply with the requirements of Section 23 05 13.

B. Disconnecting switch: For each unit, complying with NFPA 70. If factory-installed disconnecting switch is not available, provide disconnecting switch for field installation.

C. Each unit shall be factory-charged with refrigerant.

2.3 EVAPORATOR-FAN UNIT

A. Configuration: Draw-through; horizontal or vertical as shown on drawings.

B. Casing: Double-wall galvanized steel.
   1. Provide knockouts or exterior connections for power and refrigerant piping connections.
   2. Insulation: Glass fiber, minimum density 2 lbs/cubic ft (32 kg/cubic m), minimum 0.5 inch (13 mm) thick, foil faced.
   3. Finish: Manufacturer's standard industrial enamel over corrosion-resistant prime coat.

C. Refrigerant coil: Complying with ARI 210/240, aluminum fins mechanically bonded to copper tubing, with quick connections to suction and liquid lines. Designed for use with R-410A.
   1. Expansion device.
   2. Refrigerant circuit shall be controlled by a thermal expansion valve.
   3. Refrigerant line fittings shall permit soldered connections.
   4. Factory test: For leaks, and pressure test at 1.5 times working pressure.
   5. Coil shall have two circuits and interlaced circuitry.

D. Drain pan: Insulated steel or plastic, with connections to exterior of unit.
   1. Slope to drain in 2 directions.
   2. Provide access for cleaning.

E. Fan: Direct-drive, unhoused, backward-curved, plenum supply fan.
   1. Wheel: Statically and dynamically balanced at the factory.
   2. Bearings: Permanently lubricated.
   3. Fan and motor assembly shall be mounted on rubber isolators.

F. Motor: High efficiency electronically commutated motor (ECM).

G. Filters:

1. Unit filter access shall be through service access door with piano hinges and quarter turn button fasteners.
2. Unit shall include 2-inch and 4-inch-thick, pleated panel filters with MERV rating of 8 and 13, upstream of the cooling coil.

H. Hydronic heating coils: Factory-installed, aluminum fins mechanically bonded to copper tubes, with insulated cabinet finished to match the unit.

1. Factory test: To 300 psig (2070 kPa).

2.4 COMPRESSOR-CONDENSER UNIT

A. Casing: G90 galvanized steel panels.

1. Finish: Manufacturer's standard weather-resistant industrial enamel over corrosion-resistant prime coat.

B. Condenser fan: Axial flow type, directly driven, vertical discharge.

1. Wheel: Statically and dynamically balanced at the factory.
2. Motor: Condensing unit shall be provided with electrically commutated motor (ECM) condenser fan, condenser head pressure controller, and discharge pressure transducers for modulating head pressure control to allow cooling operation down to 35 degrees F. Fan motor shall be weather-protected, single-phase, direct-drive, and totally enclosed air over (TEAO) with electronic protection.

C. Refrigerant coil: Complying with ARI 210/240 aluminum fins mechanically bonded to copper tubing.

1. Integral subcooling circuit for each refrigerant circuit.

D. Compressor: Two, hermetic scroll compressors, independently circuited.

2. Crankcase heaters and oil pumps.
4. Other features:

   a. Low ambient temperature operation to 30 degrees F (-1.1 degrees C) ambient or below.
b. Modulating hot gas reheat valve on lead compressor with electronic controller.

c. Anti-short-cycle timer, 4 to 6 minutes.

d. High- and low-pressure cutouts.

e. Lead compressor shall be a variable capacity scroll capable of 10-100% modulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each unit as indicated on the drawings and in accordance with manufacturer's instructions.

B. Provide refrigeration equipment startup and service by a factory-authorized agent during a period after Substantial Completion as specified in Section 23 01 00.

C. Coordinate with air balancing to provide the proper drive and belts for fan speed to obtain the airflow and static pressure scheduled on the drawings.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

B. Provide at least 8 hours of additional instruction time for the equipment specified in this section, consisting of 1 period of 8 consecutive hours.

END OF SECTION
SECTION 23 81 27 - DUCTLESS SPLIT-SYSTEM UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductless split system with interior and exterior units and refrigerant piping.

B. Heat pump units.

1.2 RELATED SECTIONS

A. Motors: Section 23 05 13.

B. Piping: Section 23 23 00.

C. Refrigeration service and compressor warranty: Section 23 01 00.

D. Filters: Section 23 41 00.

E. Controls: Sections 23 09 01 through 23 09 23.

1.3 REFERENCES


1.4 PERFORMANCE REQUIREMENTS

A. Design of the HVAC system, including associated work of other design disciplines and trades, is based on scheduled and specified equipment. If a different item of equipment should be proposed, as permitted under the article “Acceptable Manufacturers” below, ascertain that it will:

1. Perform to the scheduled and specified capacities.
2. Make no additional demands on other systems such as domestic, heating, and chilled water, or electricity.
3. Meet or exceed all specified requirements.
4. Electrical power connections for the basis-of-design unit require the indoor unit to be wired through the outdoor unit. Other manufacturers may require separate power connections, which the contractor shall provide as required.
1.5 SUBMITTALS

A. Shop drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring diagrams: For power, signal, and control systems, differentiating between factory- and field-installed wiring.

B. Product data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model.

1. Submit product data which verifies compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.
2. Submit precharged tubing description.

C. Samples: Color chips, showing manufacturer’s complete line of finishes.

1.6 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

B. Fabricate and label refrigeration components to comply with ASHRAE 15.

C. Energy efficiency ratio and coefficient of performance: Equal to or greater than prescribed by ASHRAE 90.1.

1.7 SPECIAL WARRANTY

A. Besides general project warranty, provide manufacturer’s seven-year extended warranty for replacing compressors, for each system, executed to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled Mitsubishi Electric Corporation P Series unit, or comparable product by one of the following:

1. Daikin
2. Enviromaster International (EMI)
3. Mitsubishi Electric Corporation
4. Panasonic Air Conditioning Group
5. Trane

2.2 MATERIALS

A. Refrigerant: HFC 410a.

B. Refrigerant pipe: Precharged Type L soft drawn, preinsulated seamless copper tubing, ASTM B 280. Length: As short as possible.

2.3 UNITS, GENERAL

A. Each unit shall be provided with factory-installed means of disconnect in compliance with NEC (NFPA 70) and local codes. In the event a factory-installed disconnect is not available, provide an approved means of disconnect for field mounting.

B. Heat pump units: Include reversing valves and defrost controls. When heat is called for, the reversing valve reverses the refrigerant flow, the interior coil operates as a condenser, heat is circulated into the room, and the outdoor coil operates as an evaporator.

2.4 INTERIOR UNIT

A. Frames: Steel angles or aluminum extrusions, welded construction.

B. Panels:
   1. Insulated with 0.5-inch (13-mm) thick, 2 lbs per cubic foot (32 kg per cubic meter) density glass fiber insulation, with an R value no less than 15.
   2. Fasteners: Concealed, captive, easily operated for access without tools.
   3. Exterior finish: Manufacturer’s standard baked enamel.

C. Grilles: Each one-piece construction, aluminum, brushed finish, with foam gasket providing airtight seal between grille and cabinet. Supply grille adjustable in three directions. Return air grille hinged for access to filter.

D. Drain pan: Insulated steel or plastic, with connections to exterior of cabinet.
   1. Slope to drain in two directions, minimum 0.25 inch in 1 foot, to 0.75-inch drain connection.
   2. Provide access for cleaning.

E. Cooling coil: Aluminum fins extruded on to copper tubing with quick connections to precharged tubing. Pressure tested at 1.5 times working pressure. Provide expansion device.
F. Fan: Centrifugal type with direct-connected controlled-speed motor mounted on vibration isolators.

G. Filter: Throwaway type.

2.5 EXTERIOR UNIT

A. Unit shall be factory-assembled and -tested, of capacity and current characteristics indicated on the drawings. Unit shall be packaged type. Cabinet: weatherproof construction, steel, with baked enamel finish.

B. Refrigeration circuit: Completely pre-piped, equipped with refrigerant; access valves in suction and liquid lines; filter dryer, sight glass, and pressure fittings for charging and evacuation.

C. Compressors: Welded shell; reciprocating hermetic, rotary screw or scroll type; high efficiency.

D. Condenser coil: Constructed of copper tube and aluminum fins, factory leak-tested at 1.5 times working pressure, dehydrated, and provided with full charge of refrigerant. Provide subcooler and accumulator.

   1. Low ambient control: Provide head pressure control and accessories required to operate at temperatures down to 0 degrees F (minus 18 degrees C).

E. Fans: Propeller, direct drive, dynamically balanced, speed-controlled motor.

2.6 CONTROLS

A. Wall-mounted hard-wired controllers shall incorporate the following features:

   1. Operation mode setting (Heat, Auto, Cool)
   2. Temperature setting: The LCD indicator displays the set temperature in units of 2 degrees F.
   3. Room temperature (intake air) display
   4. 24-hour on/off timer: Operation can be set to start or stop after a specified time in 1-hour increments from 1 to 24. The remaining time is indicated on the LCD display.
   5. Fan speed indicator: Displays the fan speed setting (high or low).
   6. Vane control: The angle of the air outlet vanes can be adjusted to one of four positions by pressing the air discharge Up/Down button.
   7. Auto air swing vanes: The air outlet vanes swing up and down for uniform air distribution.
   8. Self-diagnostic display: When unit stops, the display indicates where the trouble is located.
   9. Memory feature for storing instructions
PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble and set each unit in place in accordance with the manufacturer’s instructions, plumb and level, firmly anchored, maintaining manufacturer’s recommended clearances, tight to adjoining surfaces.

B. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

C. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

D. Connect piping as shown on the drawings and in accordance with manufacturer’s instructions.

E. For wall-mounted units installed in occupied areas, provide line set covers equal to Aerco, Inc. “Slim-Duct-MD”, Rectorseal “Slimduct”, or Diversitech “Speedichannel” in a color to match indoor terminal unit. Installation shall conceal all exposed refrigerant line sets and condensate drain piping.

   1. Line set covers not required for units serving utility spaces, such as elevator machine rooms, storage rooms, and electrical rooms.

F. Test each drain pan and ensure that installed slope is as specified and pan drains completely.

G. Filters:

   1. Provide throwaway filter before energizing the unit fan.
   2. Before air balancing, remove throwaway filter and install disposable filter.

H. Install accessories required for low ambient operation.

3.2 SYSTEM CONTROLS INSTALLATION

A. Provide the entire system with required controls, including wall-mounted controller, designed and installed by the equipment manufacturer to provide a complete working system.

B. Provide wiring in compliance with the requirements of the Division 23 Section “Control System Wiring.”
3.3 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

END OF SECTION
SECTION 23 82 39 - UNIT HEATERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Unit heaters with water coils.
B. Cabinet unit heaters.
C. Propeller unit heaters.

1.2 RELATED SECTIONS

A. Supports: Section 23 05 29.
B. Motors: Section 23 05 13.
C. Filters: Section 23 41 00.
D. Controls: Sections 23 09 01 through 23 09 23.

1.3 SUBMITTALS

A. Product data: Each type of heater included in the work.
B. Samples: Color chips for finish selection, manufacturer’s complete line of colors and textures.
C. Unit shown on drawings is based on the dimensions of the design basis unit specified in Part 2 below. If another acceptable manufacturer’s unit should be proposed, ascertain that it will fit in the available space. Include, if necessary, scale drawings similar to the contract drawings, including plans, elevations, sections, and diagrams, showing any changes in wiring, arrangement, or access necessary to accommodate the proposed unit. Show complete dimensions of complete assembled unit with accessories.
D. Submit product data which verifies compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.

1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.
B. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

C. Components and installation shall comply with NFPA 70 (NEC).

D. Components and assembled units shall be listed and labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled units, or comparable product by one of the following:

1. Cabinet unit heaters:
   a. Airtherm Manufacturing Company
   b. American Air Filter
   c. Daikin Industries
   d. Rittling
   e. Sterling
   f. Trane Company
   g. Vulcan Radiator Corporation

2. Propeller unit heaters:
   a. Airtherm Manufacturing Company
   b. American Air Filter
   c. Dunham-Bush, Inc.
   d. Daikin Industries
   e. Rittling
   f. Sterling
   g. Trane Company
   h. Vulcan Radiator Corporation

2.2 CABINET UNIT HEATER

A. Arrangement, capacities, and current characteristics are indicated on the drawings.

B. Unit shall be complete with fan, motor, heating element, and cabinet with inlet and outlet grilles.

C. Cabinet: Steel, at least 18-gauge, phosphatized and finished with baked enamel in a color to be selected.
1. Cabinet shall be removable for access to motor, fans, heating element and appurtenances.
2. Cabinet front for recessed and semi-recessed units shall have overlap trim on all four sides.
3. Provide 4-inch-high subbase for surface-mounted units.

D. Fan: Forward-curved, double-inlet type, designed for quiet operation, directly driven.

E. Heating element: Constructed of copper tubes with non-ferrous fins.

F. Motor: Resiliently mounted, three-speed, tap-wound with built-in overload protection, suitable for operation on 115-V, single phase, 60-cycle current, permanent split-capacitor type. Generally, capacities are to be selected at medium or low speed. Motors shall comply with requirements of Section 23 05 13.

G. Unit controls: Unit-mounted fan-speed switch and wall-mounting, 24-volt thermostat.

H. Each unit shall have a filter rack to accommodate at least a 1/2-inch-thick filter, arranged to provide at least one sq. ft. of filter medium surface for each 300 cfm air delivery. Provide throwaway filter with each unit.

I. Provide each unit with factory-installed means of disconnect in compliance with NFPA 70 (NEC) and applicable local codes. In the event a factory installed disconnect is not available, provide an approved means of disconnect for field mounting.

2.3 PROPELLER UNIT HEATER

A. Type, capacity, and current characteristics are indicated on the drawings.

B. Casing: Steel, phosphatized and finished with baked enamel.
   1. Horizontal units: Furnished with double-deflection louver to allow for horizontal and vertical deflection of air pattern.
   2. Vertical units: Diffuser shall provide widespread discharge air pattern.

C. Heating element: Copper or copper alloy tube, welded or brazed. Extended surfaces shall be aluminum plate fins with tube expanded into collar.

D. Fan: Directly connected to single-speed electric motor and provided with wire guard. Motors shall comply with requirements of Section 23 05 13.
A. Coordinate with work of other trades to ensure that substrates and supports meet requirements for installation tolerances and other conditions.

3.2 INSTALLATION, GENERAL

A. Install unit as shown on drawings, according to manufacturer’s instructions, and in accordance with NFPA 90A.

B. Set each unit plumb and level and ensure that coils drain properly.

C. Install securely fastened in place.

3.3 INSTALLING CABINET UNIT HEATERS

A. Recessed and semi-recessed heaters:
   1. Install within ceiling grid supported from the structure.
   2. On exterior walls, provide 0.5-inch rigid fiberglass insulation behind the heater.

B. Install piping and electrical connections concealed.

C. Filters:
   1. Install throwaway filter provided with unit before energizing the unit fan.
   2. Before air balancing, remove throwaway filter and install disposable, medium-efficiency filter specified in Section 23 41 00, Particulate Air Filtration.

D. Ensure that all components are accessible when front panel is open.

3.4 INSTALLING PROPELLER UNIT HEATERS

A. Suspend from structure above with hanger rods not less than 0.5 inch in diameter.

B. Install in a manner and, if necessary, with vibration control devices so that vibration is not transmitted to the structure.

3.5 ADJUSTING

A. For cabinet unit heaters, coordinate with air balancing subcontractor to adjust fan speed to obtain the airflow and static pressure shown on the drawings. If necessary, provide belts, sheaves, or other parts required to complete balancing.

END OF SECTION
SECTION 23 84 13 - HUMIDIFIERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Steam-generating humidifier, disposable-cylinder type.

1.2 RELATED SECTIONS

A. Supports: Section 23 05 29.

B. Ductwork: Section 23 31 13.

C. Controls: Sections 23 09 01 through 23 09 23.

1.3 SUBMITTALS

A. Product data: Each type of humidifier.

B. Unit shown on drawings is based on the dimensions of the design basis unit specified in Part 2 below. If another acceptable manufacturer's unit should be proposed, ascertain that it will fit in the available space. Include, with shop drawings of the unit, scale drawings similar to the contract drawings, including plans, elevations, sections, and diagrams, showing any changes in wiring, arrangement, or access necessary to accommodate the proposed unit.

C. Shop drawings shall show complete dimensions of complete assembled unit with accessories.

D. For steam injection humidifier, submit calculations showing that the manifolds will provide absorption within the required maximum distance.

E. Operating instructions: Complete operating and maintenance data for each humidifier to be included in project Operation and Maintenance Manual specified in Section 23 01 01.

1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 23 05 00, Common Work Results for HVAC.

B. Packaged units or listed components shall be UL listed and labeled.
PART 2 - PRODUCTS

2.1 DISPOSABLE-CYLINDER STEAM-GENERATING HUMIDIFIER

A. Basis-of-design product: Subject to compliance with requirements, provide Humisteam X type self-contained, disposable-cylinder, microcomputer-controlled humidifier, model indicated on drawings, or comparable product by Herrmidifier, Carel USA, or Nortec.

B. Unit shall have the rated output of steam shown on the drawings, when operated on indicated current characteristics.

C. The humidifier shall discharge pure steam through factory-supplied steam distributors.

D. Auto-adaptive control system shall monitor and optimize the contained water conductivity, and filling and drain rate. The cylinders and auto-adaptive control system shall compensate for varying entering water conditions.

E. The fill valve shall open on automatic drain to temper the drain water before it leaves the humidifier.

F. Cylinders: Disposable type not requiring cleaning or maintenance, with published life expectancy in hours of operation at a known entering water hardness.

G. Humidifier circuitry shall distinguish between full cylinder at startup and full cylinder at end of cylinder life.

H. At the end of life, the control circuitry shall shut the humidifier off and indicate that the humidifier is off.

I. The circuitry shall provide a 24-V control signal to power a remote service indicator when a service message appears on shutdown.

J. The humidifier shall incorporate self-diagnostic control circuitry capable of monitoring abnormal conditions and preventing unsafe operation of the unit.

K. Humidifier cabinet:

1. Key-lockable access on both the plumbing and electrical doors.

L. Backflow prevention: Fill cup with 1-inch (25-mm) air gap on the fill side and an integral air gap on the drain side complying with applicable codes.

M. The unit shall automatically drain the water from the cylinder after seven days of inactivity. Upon a call for humidity, the unit shall resume normal operation.
N. Built-in contactor shall interrupt power to the electrodes when the space humidity is satisfied.

O. The unit shall be protected by internal fusing on the primary voltage lines.

P. The unit shall be protected by an automatic emergency-drain circuit to drain the humidifier to 90 percent of rated amps if the unit amps should rise too high.

Q. The humidifier shall operate with an On/Off humidistat.

R. The humidifier shall have a safety door interlock switch to open the contactor(s) when the plumbing access door is open.

S. Accessories:
   1. Modulating continuous control package, wall-mounted.
   2. Duct-mounted air proving switch.
   4. Coupled circuits to allow multiple humidifiers to operate from one humidistat.
   5. Modulating control: Allows full modulating control of humidifiers by varying signals from control systems specified in other sections.
   6. Condensate or drain water sump pump.
   7. In-line water filter for supply water.
   8. Fill cup extension kit.
  11. Steam hose, 1.75 inches (44 mm) diameter, for steam distributors.
  12. Condensate return hose, .0375 inch (10 mm) diameter.
  13. VAV control system.
  15. Low temperature protection.

T. Extra materials: Provide one replacement cylinder for each circuit of each disposable-cylinder humidifier. Label each cylinder to identify the circuit and unit for which it is intended. Deliver as required in Part 1 above.

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Install unit and accessories as shown on the drawings and in accordance with manufacturer's instructions.
B. The installer shall have the manufacturer's representative instruct and supervise the installation of the humidifiers and their controls.

C. Mount humidistat and other controls where indicated on the drawings and as recommended by the manufacturer.

D. Mount duct high-limit stat and air flow switch.

E. Install, calibrate, adjust and wire control devices.

3.2 TESTING

A. Test and adjust steam injection humidifier until vapor trail shows that absorption occurs within the required maximum distance.

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 23 05 00, provide operating instructions.

B. Provide at least 4 hours of additional instruction time for the equipment specified in this section, consisting of 1 period of 4 consecutive hours.

END OF SECTION
SECTION 26 01 01 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.11 SECTION INCLUDES

A. General provisions and requirements for electrical work.

1.14 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Commissioning requirements: Division 01.

1.20 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.


1.24 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 26.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. See Division 01 for requirements related to Owner’s occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.26 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 26 specifications.
B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in article “Substitutions” below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.
   1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
   2. Where specification permits “equal” products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.27 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 26 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.28 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project and or representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:
   1. Furnish: Supply item
   2. Install: Mount and connect item
   3. Provide: Furnish and install

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers’ instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.
H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.29 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate electrical work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all conduit, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor’s responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors’ assistants shall include a competent electrical foreman, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The foreman shall establish all basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.30 SUBMITTALS

A. Manufacturers’ and subcontractors’ lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:
1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers’ Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.

2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor’s name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.

3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.

4. All exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.

5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner’s representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

1.34 SPECIALIST
A. The term “Specialist” as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer’s direct supervision.

1.35 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:
   b. Specifications.
   c. Addenda.
   d. Change Orders and other Modifications to the Contract.
   e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.

3. Record information concurrent with construction progress.

4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:
   a. Manufacturer’s name and product model and number.
   b. Product options, substitutions, or alternates utilized.
   c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:
   a. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
   b. Field changes of dimension and detail.
   c. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:
1. Submit sets prior to final inspection as specified in Division 01. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.

2. Electronic: Submit O&M manual documentation in pdf format.

3. Internally subdivide the contents with page dividers, logically organized as described below.

4. Contents: Prepare a Table of Contents for each volume, with each product or system description identified.

5. Part 1: Directory, listing names, addresses, and telephone numbers of electrical engineers; contractor; electrical subcontractors; and major electrical equipment suppliers.

6. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
   a. Significant design criteria.
   b. List of equipment.
   c. Parts list for each component, including recommended spare parts list.
   d. Operating instructions.
   e. Maintenance instructions for equipment and systems.
   f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

7. Part 3: Project documents and certificates, including the following:
   a. Shop drawings and product data.
   b. Scans/copies of certificates.
   c. Scans/copies of warranties, guarantees, and bonds.
   d. Test reports: Copies of the results of all tests required under all sections of specifications.

8. Submit a copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.

9. Submit final volumes revised, within ten days after final inspection.

1.42 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.
C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
3. The National Fire Protection Association Code. (NFPA)

1.43 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.

1. Factory Mutual (FM)
2. American National Standards Institute (ANSI)
3. American Society for Testing and Materials (ASTM)
4. International Code Council (ICC)
5. Institute of Electrical and Electronics Engineers (IEEE)
6. National Electrical Code (NEC) (NFPA 70)
7. National Electrical Manufacturer’s Association (NEMA)
8. National Fire Protection Association (NFPA)
9. The Occupational Safety and Health Act (OSHA)
10. Underwriters Laboratory Inc. (UL)
11. American Association of State Highway and Transportation Officials (AASHTO)
12. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
13. Virginia Occupational Safety and Health (VOSH)

1.53 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

C. Store electrical construction materials such as wire, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.
1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.
2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer’s recommended temperatures.
3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.

D. Electrical equipment such as panelboards and circuit breakers stored before installation and installed during construction: Provide clean, dry locations at manufacturer’s recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.54 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer’s recommended temperatures.

E. Protect electrical materials and products from weather events and accidents of construction.

F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.55 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.60 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in “Cutting and Patching” below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.80 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties as specified in individual sections.

B. During the correction period, the Contractor shall promptly correct any work found to be defective or otherwise not in accordance with the requirements of the Contract Documents, on receipt of written notice from the Owner. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.
C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers’ standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.85 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor’s and subcontractors’ responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.11 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of conduits. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.
E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.14 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.40 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION
SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.11 SECTION INCLUDES

A. Requirements applicable to work of more than one section of Division 26.

B. Testing wiring systems.

1.14 RELATED SECTIONS

A. Operation and Maintenance Manuals: Division 01 and Section 26 01 01.

B. Painting: Division 09.

C. Commissioning requirements: Division 01.

1.21 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: A Nationally Recognized Testing Laboratory (NRTL), a National Voluntary Laboratory Accreditation Program (NVLAP), or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1.26 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed on the basis of using the particular manufacturers’ products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article “Acceptable Manufacturers,” or permitted as “equal,” are permitted provided:

1. Product shall meet the specifications.

2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.
C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

D. The contract drawings are generally diagrammatic, and do not indicate all fittings or offsets in conduit or all pull boxes, access panels, or other specialties required.

1. Install conduit exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining adequate clearance for access at parts requiring servicing.
2. Install conduit a sufficient distance from other work to permit a clearance of not less than 0.5 inch (15 mm) between its finished covering and adjacent work.
3. No conduit shall be run below the head of a window or door.
4. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.

1.30 SUBMITTALS

A. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.40 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the state, county, or city in which the work is performed.

B. Electrical control panels, equipment, materials and devices provided or installed as work of Division 26 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.

1.85 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors’ and subcontractors’ responsibilities are described in Division 01.

PART 2 - PRODUCTS

2.10 MATERIALS

A. Electrical equipment backing panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated in accordance with AWPA C27, in thickness indicated, not less than 0.5 inch (13 mm) nominal.
1. One side finished.

B. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

   1. Application: Treat items indicated on the drawings, and the following:

   a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
   b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
   c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   d. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
   e. Wood floor plates that are installed over concrete slabs-on-grade.

   C. Aircraft cable: 0.25-inch (6-mm) steel wire rope, galvanized, construction 7 by 19 strands, minimum 7000 lbs (31138 N) breaking strength.

2.21 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

PART 3 - EXECUTION

3.03 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers’ instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers’ instructions and recommendations applicable to the project conditions.

   1. Immediately notify Architect if a difference or discrepancy is found between manufacturers’ instructions and the drawings or specifications.

B. Install plywood backing panels with finished face exposed.

3.61 TESTS
A. During the progress of the work and after completion, test the branch circuits and distribution system.

B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or workmanship, immediately repair, or replace with new, the faulty installation, and retest the affected portions of the work.

C. Furnish equipment and instruments necessary for testing.

D. Tests shall demonstrate the following:
   1. Lighting, power, and control circuits are continuous and free from short circuits.
   2. Circuits are free from unspecified grounds.
   3. The resistance to ground of each non-grounded circuit is not less than one megohm.
   4. Circuits are properly connected in accordance with the applicable wiring diagrams.
   5. Circuits are operable. Demonstration shall include functioning of each control not less than ten times, and continuous operation of each lighting and power circuit for not less than 0.5 hour.

E. Test circuit breakers larger than 100 amps at full voltage.

F. Make voltage built-up tests with a voltage sufficient to determine that no short circuits exist.

G. Immediately repair defects and retest until systems are operating correctly.

H. Submit test reports.

3.81 OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.
E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner.

END OF SECTION
SECTION 26 05 01 - EXCAVATION AND FILL FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for electrical work underground inside the building and extending five feet beyond exterior building walls, and outside the building as shown on drawings.

B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 26 01 01.

B. Repairing pavements: Division 32.

C. Underground electrical ductbanks: Section 26 05 44.

D. Conduit: Section 26 05 33.

E. Service entrance: Section 26 05 41.

F. Identification for electrical systems: Section 26 05 53.

1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft (2700 kN-m/cu m).

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities and underground irrigation system, and proposed detailed trenching plan.

B. Product data: Seed and mulch.

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.

B. Grass seed: Fresh new-crop seed, 90 percent pure and 85 percent germination. Mix: 70 percent Kentucky Bluegrass, 25 percent Red Fescue and 5 percent Red Top. Only strains of Kentucky Bluegrass found adaptable to Delaware shall be acceptable.

C. Mulch: Free of sticks, weeds, or other foreign matter; either licorice root, tan root, or tan bark; fibrous by-product of extraction. Use only one type throughout the project.

2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local utility company underground information service (Delmarva Miss Utility) before beginning excavation outside buildings.

B. The general locations of underground utilities are indicated on the electrical and civil drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs’ Pipe and Cable Locators.

C. Where crossing other utilities, provide test pits to determine depth of existing utilities and coordinate installation of new outdoor services with these existing utilities as not to interrupt these existing services.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work. Repair of pavement is specified in Division 32.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.
D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the Architect.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where conduit is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:

1. Electrical conduit: Depth required by NFPA 70 (NEC).

C. Trenches shall be of necessary depth and width for the proper laying of conduit with a minimum of 8 inches (205 mm) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulation are stricter, trenches 4 ft. (1220 mm) and deeper shall have shored sides as required by OSHA trenching regulations.

2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of conduit on undisturbed soil at every point along its entire length, except for bell holes.

3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day’s operation.
4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.

5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the Architect and do not place any portion of the work on such surfaces until instructions are received.

E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

F. Excavation for structures shall be sufficient to leave a minimum of 12 inches (305 mm) and a maximum of 24 inches (610 mm) clearance on all sides. Fill over-depth excavation with concrete.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.

C. Electrical systems backfill:

1. Backfill and compact in 8-inch (200-mm) layers, to level finished grade with the excavated materials approved for backfilling.

2. Surplus earth shall be mounded up on excavation and left to settle. When directed by the Architect, surplus earth shall be removed and excavations leveled off to proper grade. Where direct burial cables are placed in trenches, first cover the cables with clean earth.

D. Structure backfill:

1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.

3.6 COMPACTION
A. Test in accordance with the requirements of ASTM D 1557.

B. Compact under slabs, roads, and sidewalks to a 95 percent density.

C. Compact unpaved areas to a 90 percent density.

D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

E. Take particular care in compaction of earth under joints of mechanical piping.

3.7 SEEDING

A. Seed disturbed grass areas at the rate of 5 pounds (2.27 kg) per 1000 sq. ft. (92.9 sq. m), with the seed mix specified.

B. Uniformly distribute seed with an approved machine to ensure a covering of plus or minus 1/4 inch (6 mm). Sow half of the seed in one direction and the rest at right angles.

C. Do not seed during windy weather or when ground is wet or otherwise untillable. Seed between the dates of March 1st to May 1st or August 15 to October 15 unless otherwise approved in writing.

3.8 MULCHING

A. Mulch seeded areas immediately following seeding with fibrous mulch evenly applied at an average rate of 2 tons per acre (4483 kg per hectare) so as to provide a loose depth of not less than 2 inches (50 mm).

B. Wet down mulch, unless a heavy rain wets it, to the Architect’s satisfaction, immediately after application.

3.9 RESURFACING

A. Resurface sidewalks, roads, streets, and other paved areas as work of this section, matching the construction and finish of adjacent paving. Paving shall meet the requirements of Division 32.

END OF SECTION
SECTON 26 05 03 - ACCESS DOORS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Access doors for concealed electrical specialties requiring maintenance or manual operation.

1.2 RELATED SECTIONS

A. Fire alarm devices: Section 28 31 00.
B. Electrical devices: Division 26.
C. Identification for electrical systems: Section 26 05 53.

1.3 SUBMITTALS

A. Product data: Each type of access door.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Wall and ceiling access doors:
   1. Milcor, Inc.
   2. Cesco Products Company
   4. Zurn Industries

2.2 WALL AND CEILING ACCESS DOORS

A. Doors: Provide Milcor model listed, or similar type and equal quality by another acceptable manufacturer.

B. Gray, prime-painted steel. Flush door, Types:
   1. Fire-rated where occurring in fire-rated walls.
   2. Style AP where occurring in acoustical plastered surfaces.
   3. Style K where occurring in hard plastered surfaces.
   4. Style MS stainless steel where occurring in masonry or ceramic tile surfaces.
   5. Style DW when occurring in dry wall construction.
C. Sizes: As required for access to the particular device, but no less than 16 by 16 inches (405 by 405 mm).

D. Recessed door panels for concealed type doors:

   1. Style AP: Acoustical plaster applied into recessed door panel for flush finish.
   2. Style AT: Matching acoustical tile applied into recessed door panel for flush finish.
   3. Style ATR: Matching material applied into recessed door panel for flush finish.
   4. Style DWR: Drywall panel applied into recessed door panel for flush finish.

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Provide access doors in walls and inaccessible ceilings for concealed specialties and appliances that require manual operation or maintenance.

   B. Select appropriate size door for each particular application.

END OF SECTION
SECTION 26 05 04 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.11 SECTION INCLUDES

A. Extent and location of demolition are shown on the drawings.

1.14 RELATED SECTIONS

A. Demolition: Division 02.

1.30 SUBMITTALS

A. Project record documents: Record drawings.

1.40 QUALITY ASSURANCE

A. Demolition shall be carried out as expeditiously as possible, in accordance with accepted practice and applicable building code provisions.

1.60 PROJECT CONDITIONS

A. If, in the course of the work, workers unexpectedly encounter a material not identified for special removal but which they suspect to be asbestos, lead, or to present some other hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

Not used.
PART 3 - EXECUTION

3.20 DEMOLITION

A. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. Demolish, remove, demount, and disconnect inactive and obsolete conduit, fittings and specialties, equipment, and fixtures.

   1. Patch and repair surface materials as required in Division 01 and Section 26 01 01 article, “Cutting and Patching.”

E. Remove the anchors, bolts, and fasteners associated with conduit and equipment to be removed.

3.24 DISPOSAL

A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition daily.

END OF SECTION
SECTION 26 05 07 - FIRESTOPPING FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-penetration firestopping in fire-rated construction.
B. Through-penetration smoke-stopping in smoke partitions.

1.2 RELATED SECTIONS

A. Conduit: Section 26 05 33.

1.3 REFERENCES

A. Underwriters Laboratories
   1. UL Fire Resistance Directory
   2. UL 1479: Through Penetration Firestops.
B. American Society for Testing and Materials Standards:

1.4 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described in referenced documents.
B. Barriers: Time-rated fire walls, smoke barrier walls, time-rated ceiling/floor assemblies and structural floors.
C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.
D. Penetration: Opening or foreign materials passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.
E. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.
1.5 SYSTEM DESCRIPTION

A. Design requirements:

1. Fire-rated construction: Maintain barrier and structural floor fire resistant ratings including resistance to cold smoke at all penetrations.
2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations.

1.6 SUBMITTALS

A. Product data: Manufacturer’s specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer’s installation instructions.

1.7 QUALITY ASSURANCE

A. Products and assemblies shall be tested and labeled by an independent, nationally recognized testing and labeling authority.

B. Installer’s qualification: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, state, or local authority where applicable.
2. At least 2 years’ experience with systems.
3. Successfully completed at least 5 projects of comparable scale, using these systems.

C. Local and state regulatory requirements: Obtain acceptance for proposed assemblies not conforming to specific rating agency classifications or rated assemblies.

D. Materials shall have been tested to provide fire rating at least equal to that of the construction in which they are to be installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:

1. Deliver products in original unopened packaging with legible manufacturer’s identification.
2. Coordinate delivery with scheduled installation date, allow minimum storage at site.
B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer’s instructions.

1.9 PROJECT CONDITIONS

A. Existing conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced-air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

1.10 WARRANTY

A. General project warranty and correction period, as required in general conditions and Division 01, requires repair or replacement of materials or systems which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer’s data as an inherent quality of the material for the exposure indicated.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers and products: Those listed in the UL Fire Resistance Directory for the UL System involved, or rated for the application by Warnock Hersey or by another acceptable rating agency.

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Provide systems or devices listed and labeled by a rating agency, and conforming to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. The system shall be symmetrical for wall applications. Systems or devices shall be asbestos-free.
1. Additional requirements: Firestopping shall withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the rated system or device, and designed to perform this function.

2. Additional requirements: Firestopping sealants shall be red in color to facilitate field verification of firestopping application.

2.3 SMOKE-STOPPING AT SMOKE PARTITIONS

A. Through-penetration smoke-stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

2.4 ACCESSORIES

A. Fill, void or cavity materials and forming materials: Classified for firestopping use, or included in a rated firestopping assembly, by a rating agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3 INSTALLATION

A. Provide firestop devices or assemblies for every opening and penetration in floors or fire-rated construction.

B. Install penetration seal materials in accordance with printed instructions of the rating agency and in accordance with manufacturer’s instruction.
C. Ensure an effective smoke barrier in each sealed penetration. Install smoke stopping as specified for firestopping.

D. Protect materials from damage on surfaces subject to traffic.

E. Where large openings are created in walls or floors to permit installation of conduits or other items, close unused portions of opening with firestopping material tested for the application.

3.4 FIELD QUALITY CONTROL

A. Examine penetration seals to ensure proper installation before concealing or enclosing them.

B. Keep areas of work accessible until inspection and acceptance by applicable authorities.

C. Before substantial completion, patch and repair firestopping cut or penetrated by other construction work.

3.5 ADJUSTING AND CLEANING

A. Clean up spills of liquid components.

B. Neatly cut and trim materials as required.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

END OF SECTION
SECTION 26 05 19 - WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wire and cable rated 600-volts and less.
B. Type MC and Type MC luminary as permitted in Part 3.

1.2 RELATED SECTIONS

A. Underground ducts and utility structures: Section 26 05 44.
B. Conduits: Section 26 05 33.
C. Lighting: Section 26 51 00.
D. Voice and data communication cables: Division 27.

1.3 REFERENCES

E. UL 83 – Standard for Thermoplastic-Insulated Wires and Cables.
F. Additional UL Standards as indicated.

1.4 SUBMITTALS

A. Product data:

1. Each type of wire and cable, including accessories.
2. Include copies of UL certifications showing compliance with requirements in “Quality Assurance” below.
B. Product schedule: Provide schedule or detailed statement on use of wires and cables. Indicate wire or cable type, product use, and representative location(s).

1. Identify proposed use of wire or cable types in locations not specifically listed in specifications or on drawings.

1.5 QUALITY ASSURANCE

A. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Products and installation shall comply with NFPA 70 and other applicable national, state, and local electrical codes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General requirements: Deliver, store, and handle wire and cable in accordance with the manufacturer’s instructions.

1. Wire and cable shall be packaged in a manner that protects them during ordinary handling and shipping. Ship from manufacturer with ends temporarily sealed against moisture.

2. Protect wire and cable during storage (both onsite and offsite).
   a. Store in a clean and dry location. Elevate from surfaces where water can accumulate, and cover cable rolls to protect against weather.

3. Handle wire and cable as recommended by the manufacturer. Do not pull from the center or periphery of the cable reel.

4. Damaged wire and cable shall be removed from the project site.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE (600-Volts Max.)

A. Conductors: UL listed and NEMA WC 70 compliant; Copper, 98 percent conductivity, suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; solid bare annealed copper for No. 10 and smaller complying with ASTM B 3, and stranded for No. 8 and larger complying with ASTM B 8.

B. Conductor insulation:

1. Type THHN/THWN-2: Comply with UL 83; PVC insulation, nylon jacket.

2. Type RHH / RHW-2: Comply with UL 44; stranded conductors, XLPE insulation.
C. Conductor identification: Markings along outer braid denoting conductor size, voltage classification, type of insulation, and manufacturer's trade name, and color code. Identification shall extend to branch circuits and outlets. Use the color coding system tabulated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.

1. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
2. Colors on conductors No. 8 and larger, or No. 4 and larger grounded and grounding conductors: Colored tape wrapped a minimum of 6 inches (150 mm) on either end of conductor.

<table>
<thead>
<tr>
<th>VOLTAGE</th>
<th>NEUTRAL</th>
<th>PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>120-V, 2-wire</td>
<td>White</td>
<td>Black, Red, or Blue, depending on phase</td>
</tr>
<tr>
<td>208/120-V wye, 3-phase, 4-wire</td>
<td>White</td>
<td>Black</td>
</tr>
</tbody>
</table>

D. Wires used solely for grounding purposes shall be green, where insulated.

E. Control wiring shall be coded with colors different from those used to designate phase wires.

2.2 WIRING ACCESSORIES

A. Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service where installed.


C. Twist-on wire connectors (damp and wet locations): Ideal Industries, Inc., UnderGround®, models 60, 64, or 66 as appropriate; King Innovation DryConn®; or equal by 3M Company. Connectors shall be listed under UL 486D.

D. Compression connectors: Color-keyed, 3M Company "Scotchlok"™ compressor connectors, "10000" series for copper conductors, "20000" series for aluminum conductors, or equal by Thomas & Betts (Blackburn) or Ilsco.
E. Compression connectors (damp and wet locations): Protect the connector's with a waterproof system, UL-listed for direct burial and 600 volts: 3M Company 8420 series, Thomas & Betts Model DBSK82, or equal by Ilsco.

F. Compression taps: Series CT-2 tap with CT-2C cover, or Series 54710 color-keyed compression taps, Burndy Corporation "Versitap" or equal by OZ/Gedney.

G. Power distribution blocks: Equal to Hubbell Burndy “U-Blok.”

2.3 ALUMINUM CONDUCTORS

A. Aluminum conductors: UL 44 listed and NEMA WC 70 compliant; suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; complying with ASTM B800 and ASTM B801. Compact, stranded Aluminum Association 8000 Series electrical conductor alloy material, equal to Alcan Cable "Stabiloy."

1. Sizes No. 2 through 750 kcmils only

B. Conductor insulation:

1. Type THHN/THWN-2: Comply with UL 83; PVC insulation, nylon jacket.

C. Connectors: Compression type.

1. UL 486B, AL7CU or AL9CU.
2. Lugs: Aluminum, tin electroplated, high conductivity, marked with wire size, die index, color code, and proper number and location of crimps.

3. Connection to bus bar: Apply UL-listed lubricant to hardware and surfaces before tightening.
   a. Aluminum bus bar. Two-hole compression lug and aluminum hardware.
   b. Copper bus bar: Two-hole compression lug, plated steel hardware, and Belleville spring washer.

4. Connection to mechanical lugs and equipment not suited for aluminum conductor termination: Aluminum compression lug with stranded copper wire pigtail, equipment lug compression body with insulating cover.

D. Termination hardware:

1. Bolts: Anodized alloy 2023-T4 and conforming to ANSI B18.2.1 and ASTM B 211 or B 221 chemical and mechanical property limits.
2. Nuts: Alloy 6061-T6 or 6262-T9 and ANSI B18.2.2.
4. Belleville spring washers: Conical; hardened steel, cadmium-plated, or silicon bronze.

2.4 UNDERGROUND CONDUCTORS


   1. Cable: UL 44 listed; NEMA WC 70 construction; 600-volt, single-conductor. Solid copper No. 10 and smaller, stranded copper No. 8 and larger; and with XLPE insulation.

2.5 PLENUM CABLES

A. Plenum cable: Insulated with material equal to Dupont “Teflon FEP,” UL classified for low flame and smoke-spread characteristics, for use in plenum areas without conduit in accordance with the requirements of NFPA 70.

   1. Communications cable: Type MPP or CMP in accordance with NFPA 70.

2.6 METAL-CLAD CABLE, TYPE MC

A. Cable: UL 83 and UL 1569 listed; 600-volt, single- or multi-circuit Type MC Cable, multi-conductor with ground conductor; aluminum or steel interlocked armor.

B. Conductors: Solid copper No. 10 and smaller, and stranded copper No. 8 and larger; conforming to ASTM B3 or B8.

C. Conductor Insulation: Type THHN/THWN insulated single conductors including ground conductor.

D. Fittings: UL 514B listed, steel or malleable iron fittings, equal to KonKore/Atkore International. Zinc die-cast fittings shall not be acceptable.

2.7 METAL-CLAD CABLE, TYPE MC LUMINARY CABLE

A. Cable: UL 66, UL 83, UL 1569, and UL 2556 listed; 600-volt, single- or multi-circuit Type MC luminary cable; multi-conductor with power conductors, control conductors, and ground conductor; aluminum or steel interlocked armor.

   1. Power conductors: Solid copper, Type THHN insulation, No. 10 and No. 12 AWG.
   2. Control conductors: Solid copper, Type TFN insulation, twisted pair No. 16 AWG.
B. Fittings: UL 514B listed, steel or malleable iron fittings, equal to KonKore/Atkore International. Zinc die-cast fittings shall not be acceptable.

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Where aluminum conductors are proposed for feeders to equipment, verify with the manufacturer of the approved equipment, before beginning feeder installation, that aluminum wiring is compatible. Where aluminum is not compatible with equipment, provide copper wiring.

3.2 INSTALLATION, GENERAL

A. Provide wire and cable indicated in accordance with national, state, and local electrical codes.

B. Conceal wire and cable in new construction and in locations with finished walls, ceilings, and floors unless otherwise noted on drawings.

C. Wire and cable serving systems over 100-volts shall be installed in raceways, except where otherwise noted on drawings.

D. Wire and cable serving systems rated below 100-volts shall be installed in raceways, except where otherwise noted in individual specification sections. Refer to paragraph “INSTALLING CABLE RATED BELOW 100-VOLTS” below for additional information.

3.3 INSTALLING INTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.

1. 120-volt branch circuits:
   a. Homerun from first outlet to panel: No. 12 when run is 50 feet (15,000 mm) or less; No. 10 when run is between 50 feet (15,000 mm) and 100 feet (30,000 mm); No. 8 when run is more than 100 feet (30,000 mm).
   b. First outlet to other outlets: No. 12.

2. Exit light and emergency lighting circuits: No. 10. Do not install in raceways, outlet boxes, or other locations with non-emergency wiring systems.

3. Other systems (over 100-volts): Minimum No. 12 unless specified or shown on drawings to be smaller.
B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

1. Feeders, exposed: Type THHN/THWN-2, single conductors in raceway.
2. Feeders, concealed in ceilings, walls, partitions, and crawlspaces: Type THHN/THWN-2, single conductors in raceway.
3. Feeders, concealed in concrete and below slab-on-grade: Type THHN/THWN-2, single conductors in raceway.
4. Feeders, underground: Type RHW-2, single conductors in raceway.
5. Feeders, concealed in raised flooring or partitions: Type THHN/THWN-2, single conductors in raceway.
6. Branch circuits, concealed in ceilings, walls, and partitions:
   a. Type THHN/THWN-2, single conductors in raceway.
   b. Metal-clad cable, Type MC cable and MC luminary cable - Refer to section “INSTALLING MC CABLE” below for acceptable locations.
7. Branch circuits, exposed: Type THHN/THWN-2, single conductors in raceway.
8. Branch circuits, concealed in concrete and below slab-on-grade: Type THHN/THWN-2, single conductors in raceway.
9. Branch circuits, underground: Type XHHW-2, single conductors in raceway.
10. All other applications: Provide Type THHN/THWN-2, single conductors in raceway.

C. Splicing shall be done in outlet boxes and junction boxes and not in conduit.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors or solderless connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

D. Wiring in high ambient temperature areas shall be of types required by NFPA 70 including on rooftops.

E. Wires shall be neatly shaped in panels, troughs, boxes, and appurtenances.

3.4 COORDINATION WITH DEVICES AND EQUIPMENT

A. Where conductor size or parallel conductors shown on drawings connect to terminals on devices or equipment which is not sized for the connection:

1. Provide a junction box as near the equipment as possible, but no more than 10 feet (3 m) away. Obtain approval of location before installing.
2. Provide conductor(s) sized to the ampacity of the equipment, from equipment to junction box.
3. In the junction box, splice the conductors from the equipment to the conductors of sizes, or parallel conductors, shown on the drawings.

3.5 INSTALLING EXTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.
   1. 600-volt branch circuits: Copper, No. 10 minimum.
   2. Exterior lighting circuits: Copper, No. 10 minimum.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.
   1. Feeders and branch circuits, exposed: Type THHN/THWN-2, single conductors in raceway.
   2. Feeders and branch circuits, underground: Type RHW-2, single conductors in raceway.
   3. Service entrance: Type THHN/THWN, single conductors in raceway.

C. Splicing shall be done in outlet boxes and junction boxes and not in conduit. Treat these boxes as wet locations.
   1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors. Use tools recommended by the manufacturer.
   2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
   3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

3.6 INSTALLING ALUMINUM CONDUCTORS

A. Feeder sizes and associated conduit sizes shown on the drawings are based on the use of copper conductors. Where aluminum conductors are used, increase the size of conductors and conduits to provide the same ampacity as the specified copper conductors.

B. Do not install aluminum conductors where verification of conditions proves conductors are not compatible with equipment.

3.7 INSTALLING CABLE RATED BELOW 100-VOLTS

A. Install in raceway, unless otherwise indicated in individual specification sections.
B. Where individual specification sections allow cable to be installed either in raceway or on J-hooks, install as follows:

1. Wiring method:
   a. Wiring in walls, in concrete floors, above inaccessible ceilings, where exposed in finished spaces, exposed on walls, and wherever it may not be accessible or may be subject to physical damage: Install cables in raceway.
   b. Wiring exposed in ceilings of unfinished spaces: Install cables in raceway or on J-hooks.
   c. Wiring concealed above accessible suspended ceilings: Install cables on J-hooks.
   d. Wiring in ceiling spaces of communications equipment rooms: Install cables on cable trays.
   e. Wiring within enclosures, consoles, cabinets, desks, and counters: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and/or distribution spools.

2. Conceal raceway and cables, except in unfinished spaces and in open ceiling spaces.

3. Cable not in raceways or on cable tray:
   a. Do not install in hangers used for pipes, electric conduits, or ceiling hangers, nor support it in any way by attachments to pipes, conduits, or ceiling hangers.
   b. Install without damaging conductors, shield, or jacket. Cables shall not run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
   c. Install away from potential EMI sources, including electrical power lines and equipment.
   d. Install parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

4. Cable support with J-hooks:
   a. Install J-hooks at intervals not exceeding 60 inches.
   c. Provide separate J-hooks for each low-voltage system.

5. Each cable run shall contain an ‘S’ loop or other means to accommodate expansion or contraction.

6. Where ceiling plenums are used for passage of air by heating and air conditioning system, install cable in conduit or use UL listed plenum cable.
C. For cable installed in conduit, comply with requirements for raceways and boxes specified in Section 26 05 33, Conduits, and Section 26 05 34, Boxes.

1. Provide separate conduit systems for each low-voltage system.
2. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
   a. Pull cables simultaneously if more than one is being installed in same raceway.
   b. Use pulling compound or lubricant, if necessary. Use compounds that will not damage conductor or insulation.
   c. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage cables or raceway.

D. Avoid installing near hot utilities, which might adversely affect system performance or result in damage to the cable. If cable must be placed close to such utilities, keep it separate and protect with insulation.

E. Cable bends shall have a radius not less than the value recommended by the cable manufacturer.

F. Tag cables connected to electronic equipment, to show function and the location of other end. Securely fasten labels to the cable.

3.8 INSTALLING MC CABLE

A. Install in compliance with NFPA 70.

B. Sizes: Cables larger than No. 8 shall not be permitted.

C. Locations: Type MC cable may be used only in non-animal or non-wash down spaces for branch circuits concealed in accessible ceiling spaces, in drywall partitions, or within casework.

1. Light fixture whips from junction box in ceiling to recess mounted lighting fixtures. Whips shall not exceed 6 feet in length.
2. MC cable may be used in metal stud walls between wiring devices and from wiring device up to ceiling and nearest junction box.
3. Provide junction box in accessible ceiling space of each room and terminate MC cables in room at box.
4. MC cabling shall not be used between ceiling junction boxes and homeruns back to panelboard. Homeruns shall be wire in raceway.
5. Do not install in masonry partitions or masonry walls.
6. Do not use in mechanical/electrical spaces.

D. Connect cable with wiring accessories specified above.
E. MC cable run to switches shall have a neutral conductor. This conductor is not indicated on the drawings.

F. Install in lengths no longer than 12 feet, terminating at junction box or outlet box at each end.

3.9 INSTALLING MC LUMINARY CABLE

A. Install in compliance with NFPA 70.

B. Locations: Type MC luminary cable may be used only in non-animal or non-wash down spaces above ceilings for LED lighting fixtures with dimmable drivers controlled by a Class 2, low-voltage 0-10VDC controller; connections between the controller and lighting fixtures within a space.

C. Connect cable with wiring accessories specified above.

D. Cable larger than No. 10 shall not be permitted.

E. Maximum length: 12 feet.

END OF SECTION
SECTION 26 05 21 - WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Power and control wiring for equipment.

1.2 RELATED SECTIONS

A. Equipment: Installed items requiring electricity, specified in other sections or shown on drawings.

B. Motors: Section 22 05 13 and 23 05 13.

C. Control systems wiring: Section 23 09 02.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduits, wires and cables; devices, and accessories as specified in other sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide power wiring from the motor starters to each motor and its manual controlling device. Interlock and control wiring related to the automatic temperature control system shall be provided under Section 23 09 02, Control Systems Wiring.

1. Make flexible or liquid tight connections as specified in Section 26 05 33, Conduits.

B. Except where provided with equipment, furnish and install manual pushbutton stations and pilot lights, with wiring. Where stations and pilot lights are grouped at central locations, mount them under a common faceplate.

C. Rough in and connect to laboratory, equipment furnished under other sections, and equipment furnished by Owner. Make connections as indicated on drawings with exact locations and details determined by approved shop drawings of the equipment.

1. Under equipment sections, equipment will be set in position and the electrical devices and components furnished loose. Assemble, install, and wire under this section.
2. Accomplish rough-in from walls with flush outlet boxes and from floors by means of conduit couplings finishing flush with finished floor.

D. Certain equipment, as indicated, will be furnished with control panels and auxiliary control components. Mount the panels, furnish and install source wiring and disconnects, and completely connect controls and motors.

E. Provide source wiring, connections, and disconnects for mechanical heating, ventilating, and air-conditioning (HVAC) equipment specified in Division 23. Refer to sections of Division 23 for equipment and controls.

1. Provide weathertight enclosures for disconnects for outdoor equipment.
2. Mount starters where required, and provide proper size overload protection.
3. Where capacitors are required for power factor correction as specified in 23 0513, Common Motor Requirements for HVAC Equipment, connect the capacitors.

F. Roof exhaust fans will be equipped with factory-wired disconnects located adjacent to the motor under the ventilator hoods as specified in Section 23 34 00, HVAC Fans. Exhaust fans shall be controlled by various means as indicated on drawings.

1. For fans shown to be manually controlled, furnish and install a manual motor starting switch with pilot light, located where indicated.
2. Where necessary for larger and three-phase motors, provide magnetic starters.
3. Where fans are provided with electrically operated dampers, provide wiring and relays for single-phase damper operators on three-phase motors.

G. Cabinet unit heaters will be equipped with a manual motor starting switch with overload protection, located within the cabinet. Provide source wiring to line side of this switch. Automatic control of these units will be as described in Control Sequences.

H. Where a Division 23 section requires installation of equipment under supervision of equipment manufacturer’s representative, coordinate electrical installation to cooperate with representative’s requirements.

I. Provide power sources for Owner-furnished equipment.

J. Provide power and control wiring for emergency generator, controllers, remote control panels and remote alarm bell. Mount remote bell and silence switch where indicated. Provide plastic nameplates under bell and switch.

K. Provide wiring where required to time clocks provided as specified in automatic temperature controls sections.

END OF SECTION
SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding electrical systems and equipment.
B. Ground system test.

1.2 RELATED SECTIONS

A. Gas flexible pipe connector: Section 23 11 26.

1.3 REFERENCES

A. ANSI/TIA/EIA J-STD-607
B. IEEE STD 142
C. NFPA 70
D. ASTM F467 and F468
E. UL 467

1.4 DEFINITIONS

A. Area served by a separately-derived system: The area within the building that contains any part of a circuit of the system.
B. IBGB: Intersystem Bonding Termination Grounding Busbar.
C. TMGB: Telecommunications Main Grounding Busbar.
D. TGB: Telecommunications Grounding Busbar.

1.5 SUBMITTALS

A. Product data: Ground rods and connections.
B. Certifications: System test.

PART 2 - PRODUCTS
2.1 MANUFACTURED UNITS

A. Ground conductor, unless specifically noted otherwise, shall be copper, 98 percent conductivity, solid for No. 10 AWG and smaller and stranded for No. 8 AWG and larger.

B. Grounding busbar: Predrilled rectangular bars of electro-tin plated copper, 0.25 inches (6.3 mm) thick, 12 inch (300 mm) long, unless otherwise indicated on drawings, with 0.3125 inch or 0.4375 inch (7.9 mm or 11.1 mm) diameter holes horizontally spaced 1 to 1.125 inches (25.4 to 28.6 mm) apart.

1. Intersystem bonding termination grounding busbar (IBGB) and telecommunications main grounding busbar (TMGB) shall be 4 inches (101.6 mm) wide, with four rows of holes. Telecommunications main grounding busbar shall comply with ANSI/TIA/EIE J-STD-607.

2. Stand-off insulators for busbar shall be flame-resistant fiberglass-reinforced thermoset polyester, UL recognized per UL Standard 891.

C. Ground rods: Copper bonded steel, 0.75 inch diameter by 10 feet long, one end pointed and the other end tinned, equal to the product of Erico International Corporation.

D. Mechanical type ground connectors:

1. Connectors: IEEE 837 and UL 467 compliant, equal to FCI Burndy G Series, listed for use for specific types, sizes, and combinations of conductors and connected items.

2. Nuts, bolts, and washers: Silicon bronze alloy type B per ASTM F467 and F468.

E. Exothermic type ground connections: Exothermic welding systems shall be equal to “Cadweld,” manufactured by Erico International Corporation.

F. Lugs: Lugs shall be two- or four-hole, equal to Burndy Hylug series.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide the complete grounding of conduit systems, electrical equipment, conductor and equipment enclosures, motors, transformers, and neutral conductors in accordance with applicable codes. Grounded phase and neutral conductors shall be continuously identified. Continuity of metal raceways shall be insured by double locknuts.

B. Furnish and install main grounds for secondary electrical service to cold water main in accordance with NEC requirement. In addition to the cold water ground, provide ground rods as indicated or as required by NEC and applicable codes.
C. Grounding busbar: Busbars shall stand off the wall a minimum of 2 inches (50.8 mm). Mount 6 inches (152.4 mm) above finished floor unless otherwise indicated. Insulate the busbar from its supports.

1. Conductors connecting busbar to other busbars, and to the grounding electrode system shall be attached to busbar with exothermic welds.
2. Connect other conductors to busbar using lugs.

D. Install copper grounding jumpers of 3/0 copper cable around each main water valve in the building. Install copper grounding jumpers around conduit expansion fittings. Jumpers shall be of adequate current carrying capacity corresponding to size of conduit.

E. Ground system connections which are beneath the floor and in a concealed or inaccessible location shall be brazed or welded. Brazing and welding shall be “CADWELD.”

F. 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 strap 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. Use exothermic-welded connections for outdoor locations; if a disconnect-type connection is required, use a bolted clamp secured with a minimum of two bolts and lock washers.

3.2 EQUIPMENT GROUNDING AND BONDING

A. Provide insulated equipment grounding conductors to all feeders and branch circuits.

B. 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.

C. 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.

D. Signal and communication equipment: In addition to grounding and bonding required by NFPA 70, provide grounding systems complying with requirements in ANSI/TIA/EIA J-STD-607-A.

1. Telephone and data equipment may share a common grounding system.
a. Provide a No. 4 AWG minimum conductor from the IBGB to a TMGB, located in the telecommunications entrance facility.

E. Gas piping:

1. Comply with NFPA 54.
2. Provide bonding jumpers for each length of corrugated stainless-steel tubing (CSST).
   
a. Jumpers shall be No. 6 AWG or the same size as the equipment grounding conductor serving the equipment served by the CSST, whichever is larger.
   
b. Install in accordance with CSST manufacturers’ instructions and NFPA 54.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Grounding handholes: Install a driven ground rod through handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout. Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each handhole, to ground rod or grounding conductor. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.4 APPLICATIONS

A. Underground grounding conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

3.5 IDENTIFICATION

A. Comply with requirements in Section 26 05 53, Identification for Electrical Systems, for instruction signs. The label or its text shall be green.

B. Install labels at the ends of telecommunications bonding conductors and the grounding electrode conductor where exposed.

1. Label text: “If this connector or cable is loose or must be removed for any reason, please call the building telecommunications manager.”

3.6 GROUNDING SYSTEM TEST
A. Ensure that grounding system is continuous and that resistance to earth is not more than 10 ohms.

B. Test each ground rod for resistance to earth before making connections to rod; tie grounding system together and test for resistance to earth.

C. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.

D. Submit written results of each test including location of rods as well as resistance and soil conditions at time measurements were made.

END OF SECTION
SECTION 26 05 28 - EQUIPMENT FOUNDATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment foundations (housekeeping pads).
B. Outdoor equipment foundations.

1.2 RELATED SECTIONS

A. Service entrance: Section 26 05 41.
B. Generators: Section 26 32 13.

1.3 SUBMITTALS

A. Product data: Concrete mix, grout, reinforcement, and accessories.
B. Certifications: Test report showing strength of concrete.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Concrete:

1. Indoor: 3,000 psi (20.7 MPa) compressive strength at 28 days.
2. Outdoor: 4,500 psi (31.0 MPa) compressive strength at 28 days.

2.2 GROUT

A. Non-shrink grout: Premixed, consisting of non-metallic aggregate, cement, water-reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi in 28 days.

1. Five Star Products, Inc. “Five-Star Grout”
2. L&M Construction Chemicals, Inc. “Crystex”
3. Sonneborn “Sonogrout”

2.3 METAL REINFORCEMENT

A. Reinforcing bars: Deformed steel bars in accordance with ASTM A615, Grade 60, clean
and free from loose rust, scale, or other coatings that will reduce bond.

B. Welded wire fabric reinforcing: ASTM A 185 No. 6 steel wire spot-welded at intersections and of size 6 by 6 inch mesh.

C. Metal accessories: Include spacers, chairs, bolsters, ties, and other devices necessary for properly placing, spacing, supporting and fastening reinforcement in place.

PART 3 - EXECUTION

3.1 INSTALLING EQUIPMENT FOUNDATIONS (HOUSEKEEPING PADS)

A. Provide 4-inch-high concrete foundations (housekeeping pads) for floor-mounted equipment unless otherwise noted. Furnish foundations, bolts, sleeves, and appurtenances and install as recommended by equipment manufacturer. Anchor the concrete foundations by dowels inserted into the floor slab. Provide welded wire fabric reinforcement.

B. Unless otherwise specified, install concrete work in accordance with the requirements of Division 03.

C. Equipment shall be properly aligned. Level and grout equipment where necessary. Support conduit independently of equipment and so as not to cause a strain or thrust.

D. Coordinate exact locations and configurations of equipment, foundations, and supports with the approved shop drawings of the equipment.

3.2 INSTALLING OUTDOOR EQUIPMENT FOUNDATIONS

A. Provide equipment foundations of size and thickness indicated.

B. Place reinforcement accurately in position shown, securely fasten, and support to prevent displacement before or during pouring. Clean, bend, place, and splice reinforcement in accordance with approved shop drawings. Lap ends and sides of mesh reinforcement in slabs not less than one mesh.

1. Coverage of main reinforcing shall be as follows: Slabs, 0.75 inch (19 mm); concrete poured against earth, 3 inches (75 mm); other locations, 2 inches (50 mm).

C. Properly align, level, and grout equipment.

END OF SECTION
SECTION 26 05 33 - CONDUITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit and accessories, aboveground and below ground where not in duct banks.

1.2 RELATED SECTIONS

A. Exterior duct banks, and handholes: Section 26 05 44.

B. Firestopping: Section 26 05 07.

C. Boxes: Section 26 05 34.

D. Trenching: Section 26 05 01.

1.3 DEFINITIONS

A. FMC: Flexible metal conduit.

B. LFMC: Liquid-tight flexible metal conduit.

1.4 SUBMITTALS

A. Product data:

1. Each type of conduit included in the work, and related fittings.
3. Hangers and fasteners.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

B. Steel conduit and tubing:

1. AFC Cable Systems, Inc. (FMC and LFMC)
2. Allied Tube & Conduit; a Tyco International Ltd-Co.
3. O-Z/Gedney, Unit of General Signal
4. Wheatland Tube Co.
C. Steel conduit fittings:

1. Appleton Electric Co.
2. Cooper Crouse-Hinds.
4. O-Z/Gedney; Unit of General Signal.
5. Spring City Electrical Manufacturing Co.
6. Thomas & Betts Corporation
7. Wheatland Tube Co.

D. Nonmetallic conduit, tubing and fittings:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Arnco Corp.
3. Beck Manufacturing
4. CANTEX Inc.
5. Certainteed Corp.; Pipe and Plastics Group
6. Lamson & Sessions; Carlon Electrical Products

E. Wiring troughs and fittings:

2. Lamson & Sessions, Carlon Electrical Products
3. Square D Schneider Electric

F. Conduit hangers and supports:

1. Thomas & Betts “Kindorf”
2. Tyco Power-Strut
3. Unistrut Diversified Products

G. Fasteners:

1. Caddy Fasteners by Erico Products Inc
2. ITW Ramset “Red Head”
3. Wej-It Fastening Systems

2.2 CONDUIT AND FITTINGS

A. Galvanized steel conduit: Hot-dip galvanized with threads galvanized after cutting, one of the following:

1. Rigid full weight, heavy-wall steel conduit (RGS) conforming to UL 6 and ANSI C80.1.
2. Intermediate steel conduit (IMC) conforming to UL 1242 and ANSI C80.6.

B. Steel conduit fittings: Cast malleable iron fittings with smooth finish and full threaded hubs. Include steel or malleable iron locknuts, bushings, and other fittings.

1. Insulating bushings: Equal to Thomas & Betts Series 22.
2. Hub fittings with recessed sealing ring and nylon insulated throat equal to Thomas & Betts Series 370.
3. Fittings for exposed locations: Conduit outlet bodies, zinc or cadmium plated.

C. Electrical metallic tubing (EMT): Hot-dip galvanized or sherardized thin-wall steel conduit conforming to UL 797 and ANSI C80.3.

D. Connectors and couplings for EMT: Concrete- or rain-tight, compression type, made of zinc- or chromium-plated steel. Connectors shall have nylon insulating throats.

1. Compression connector equal to Thomas & Betts No. 5223.
2. Compression coupling equal to Thomas & Betts No. 5220.

E. Flexible metal conduit (Type FMC): Made of sheet metal strip, interlocked construction, conforming to UL 1.

F. Liquidtight flexible metal conduit (Type LFMC) shall conform to UL 360.

G. Connectors for flexible metal conduit: Equal to angle wedge “Tite-Bite” with nylon insulated throat, Thomas & Betts Series 3110 and 3130.

H. Liquidtight type connectors: UL 14814A. Fittings: With nylon insulated throat, equal to Thomas & Betts Series 5331.

I. Plastic conduit: Polyvinyl chloride (PVC) Schedule 40, rated for use with 90-degree conductors, for exposed, underground, and encased applications, complying with NEMA Specification TC-2 and UL 651.

J. Plastic conduit fittings and cement:

1. Fittings: Complying with NEMA TC 3 and UL 514.
2. Cement: Solvent cement made by the manufacturer of the conduit and fittings.

K. Wiring troughs: Steel wiring trough with hinged cover, UL listed as wireways and auxiliary gutters, equal to Square D “Square-Duct.”

1. Cover: Opening complete width and length of trough;
2. Finish: Baked enamel.
L. Fittings for wiring troughs: Made with removable covers to permit installation of a complete system with access to wires throughout the system, UL listed with the troughs. Connections: Threaded screws at every connector.

M. Weatherproof expansion fittings: With bonding jumpers, equal to O-Z/Gedney types AX and TX.

2.3 SLEEVES FOR RACEWAYS

A. Steel pipe sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
   1. Sleeves for exterior walls: Anchor flange welded to perimeter.

B. Sleeves for rectangular openings: Galvanized sheet steel of length to suit application. Minimum thickness:
   1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm): 0.052 inch (1.3 mm).
   2. For sleeve cross-section rectangle perimeter equal to or more than 50 inches (1270 mm) and 1 or more sides equal to or more than 16 inches (400 mm): 0.138 inch (3.5 mm).

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 05 07.

2.4 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annual space between sleeve and conduit.
   1. Sealing elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   2. Pressure plates: Stainless steel. Include two for each sealing element.
   3. Connecting bolts and nuts: Stainless-steel of length required to secure plates to sealing elements. Include one for each sealing element.

2.5 ACCESSORY MATERIALS

A. Pull rope: Equal to Graybar Electric Co., Inc., “Pro-Pull”: Polypropylene, minimum 0.1875 inch (5 mm) thick, tensile strength 800 lbs (3559 N), work load 130 lbs (578 N).

B. Caps and plugs: Equal to Thomas & Betts Series 1470.

D. Bituminous protective coating: Coal tar based, self-priming on steel, applied in a wet film thickness at least 22.0 mils (559 microns) per coat.

E. Rust inhibitive paint: Alkyd based, equal to Benjamin Moore Super Spec HP D.T.M. Alkyd Low Lustre P23; white, black, or bronzetone; applied in a wet film thickness of at least 2.9 mils.

2.6 CONDUIT HANGERS

A. Adjustable hangers: Equal to Kindorf C-711 lay-in hanger or C-710 Clevis hanger.

B. Trapeze hangers: Constructed of channels with Kindorf C-105 notched steel straps.

C. Channels: Steel, 1.5 inches (38 mm) wide with 7/8-inch (22-mm) continuous slot, gauges and weights equal to Kindorf B-900 series.

D. Beam clamps: Equal to Kindorf E-160 or U-569 adjustable type, for connecting hanger rod to steel beam.

E. Hangers for conduit 1.0 inch (27 mm) and smaller, through or below bar joists: “Hang-on” hangers attached to joist, with Minerallac scissor clips or two-piece stud clips.

F. Finish: All hangers, assemblies, plate washers, rods, locknuts, channels, bolts, and appurtenances shall be hot-dip galvanized.

2.7 FASTENERS

A. General: Select fasteners such that load applied does not exceed one-fourth of manufacturer’s load capacity in 3500 psi (24000 kPa) concrete.

B. Fasteners to concrete: Self-drilling type expansion anchors, or machine bolt drop in anchors for drilled holes. Fasteners to concrete ceilings shall be vibration- and shock-resistant.

C. Fasteners to drywall or cavity wall: Toggle bolts, hollow-wall drive anchors, or nylon anchors as required.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide complete, separate and independent raceway system for each of the various wiring systems including, but not limited to, the following:
1. Lighting
2. Power
3. Exit Lighting*
4. Fire Alarm System
5. Low Voltage Control System
6. Control Wiring
7. Voice and Data Systems
8. Security Systems

*These wiring systems may be installed in common raceways.

B. Wire all raceway systems completely, except where otherwise indicated, as shown on drawings and as required for satisfactory operation of each system.

C. Where wiring troughs are required or used to facilitate the installation, size them to accommodate conductors, in accordance with NFPA 70.

D. Types and locations of conduits are scheduled at the end of the section.

E. Do not install conductors or pull rope during installation of conduit.

F. Where conduit is connected to a cabinet, junction box, pull box, or auxiliary gutter, protect the conductors with an insulating bushing. Provide locknuts both inside and outside the enclosure. Where conduit is stubbed up to above ceilings for future wiring, close ends with bushings.

G. Bituminous protective coating:

1. Coat exposed threads on steel conduits in concrete slabs at couplings and fittings, after joints are made up.
2. Coat metallic conduits below grade not in concrete, and where emerging from below grade or slabs, four inches above and below grade or slab.

H. Rust-inhibitive paint:

1. Exposed threads of exterior conduit.
2. All unfinished metal components.

I. Make turns in conduit runs with manufactured elbows or using machines or tools designed to bend conduit. Turns shall be not less than the various radii permitted by NFPA 70.

J. Sizes:

1. Do not use conduit smaller than 0.75 inch (21 mm).
2. Feeder conduits shall be as large as indicated, or as required by NFPA 70 (whichever is larger). Do not install more than one feeder in a single conduit.

3. Conduit sizes shown on drawings are based on Type THHN/THWN wire, unless otherwise noted.

K. Make vertical runs plumb and horizontal runs level and parallel with building walls and partitions.

L. Ground conduits as required by NFPA 70.

M. Where conduits pass through building expansion joints, and wherever relative movement could occur between adjacent slabs, equip with weatherproof expansion fittings and bonding jumpers.

N. Where conduits through roof cannot be installed inside equipment or pipe curbs, flash them in accordance with the SMACNA Architectural Manual.

1. Coordinate flashing details and materials with manufacturer and installer of roofing system.
2. Pitch pockets are not permitted.

O. Run conduits concealed in new construction except where connecting to surface-mounted cabinets and equipment, and in electrical and mechanical equipment spaces. Install conduit above suspended ceilings and within walls and partitions.

P. Conduits installed below slab on grade shall be installed below the vapor barrier. Patch and seal or replace vapor barrier at location of penetration.

Q. Immediately after each run of conduit is completed, test it for clearance, smooth the joints, and close at each end with caps or plugs to prevent entrance of moisture or debris.

R. Conduit installed outdoors or at indoor locations exposed to continuous or intermittent moisture shall provide a liquidtight seal. Use steel or malleable iron hub fittings. Coat exposed threads with bituminous protective coating.

S. Install no conduit in these locations:

1. Setting beds for terrazzo or tile.
2. Concrete toppings, unless specifically approved by Structural Engineer.

T. Conduit in concrete decks above grade: Not permitted.

3.2 INSTALLING PULL BOXES, JUNCTION BOXES, OUTLET BOXES

A. Install as specified in Section 26 05 34, Boxes.
B. Install pull or junction boxes in long runs of conduits or where necessary to reduce the number of bends in a run.

1. Select inconspicuous locations. Do not install until locations have been approved by the Architect.
2. Install boxes flush with wall or ceiling surfaces, with flat covers. Where removable ceiling units are used, locate boxes above ceilings.

C. Verify door swings with door frame installed before locating switch outlets.

3.3 INSTALLING FLEXIBLE CONDUIT

A. Installation shall comply with NFPA 70.

1. Minimum length: Two feet (610 mm).
2. Maximum length: Six feet (1830 mm).

B. Make immediate connections to recessed lighting fixtures, speakers, and other equipment in suspended ceilings with flexible metal conduit. Include sufficient slack to permit removal of fixture or equipment.

C. Make immediate connections to motors and transformers with liquidtight flexible conduit. Include sufficient slack to reduce the effects of vibration.

D. In wet locations, install liquidtight type, in such a manner that liquid tends to run off the surface and not drain toward the fittings.

E. Where fittings are brought into an enclosure with a knockout, install a gasket assembly consisting of an O ring and retainer on the outside.

3.4 INSTALLING PULL ROPE AND CONDUCTORS

A. After conduit is installed, fish pull rope. After completion of the work of this project, pull rope shall remain in conduits identified as to be left empty.

B. Do not use a pull rope that has a tensile strength of more than one of the conductors of a two-wire circuit, more than two of the conductors of a three-wire circuit, or more than three of the conductors of a four-wire circuit.

C. Do not pull conductors into the conduits until the system is entirely completed and wet building materials are dry.

D. Use only a lubricant approved for use with conductor materials and pull rope materials.
3.5 INSTALLING SLEEVES

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 05 07.

B. Concrete slabs and walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Fire-rated assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

D. Cut sleeves to length for mounting flush with both surfaces of walls.

E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

F. Size pipe sleeves to provide 0.25-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

H. Interior penetrations of non-fire-rated walls and floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.

I. Fire-rated-assembly penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Section 26 05 07.

J. Roof-penetration sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

K. Exterior-wall penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
3.7 INSTALLING CONDUIT HANGERS

A. Single runs of overhead conduits 1.25-inch (35-mm) size and larger shall be supported by adjustable hangers, using 0.375-inch (10-mm) rods for conduits up to 2.0 inch (53-mm) size and 0.5-inch (13-mm) rods for conduits larger than 2.0 inches (53 mm).

B. Support groups of conduits run in parallel on trapeze hangers suspended from 0.5-inch (13-mm) hanger rods.

C. Space hangers not over 10 feet (3 m) apart. Support conduits within 3 feet of each outlet, junction or pull box.

D. Below bar joist construction, support hangers from a length of structural channel, welded to the top chords of at least two joists.

E. Where large numbers of conduits are grouped together, stagger individual hangers so as not to concentrate the load on a few joists.

F. Where hanger rods are attached to structural beams, use adjustable beam clamps.

G. Below precast plank construction, hanger rods shall pass through the precast planks and be secured on top side with nut, locknut and plate washer. Plate washers shall be at least 4 inches (102 mm) square and 0.125 inch (3.2 mm) thick. Top of hanger assembly shall be concealed in the concrete fill which will be placed over the planks.

H. Attach hanger rods to concrete with expansion bolts and anchors.

3.8 INSTALLING UNDERGROUND CONDUIT, GENERAL

A. Depth:
   1. Buried under building slabs: Top of conduit no less than 12 inches below the vapor barrier. Seal around conduits where they penetrate the vapor barrier.
   2. Outside building: Top of conduit no less than 24 inches below finish grade.

B. Slope: At least 3 inches in 100 feet away from buildings and toward drainage points.

C. Cleaning: At the completion of each run, in each conduit, first run a testing mandrel not less than 12 inches (305 mm) long with diameter 0.25 inch (6.35 mm) less than the inside diameter of the conduit; then draw through a stiff-bristled brush until all particles are removed. Immediately install conduit plugs.

D. Except at conduit risers, make changes in direction of runs, either vertical or horizontal, by long sweep bends. Bend may be made up of one or more curved or straight sections or combinations. Use manufactured bends with a minimum radius of 36 inches.
E. Where underground nonmetallic conduit runs penetrate floor slabs, penetrations shall be made with metallic elbows. Coat metallic elbows with bituminous protective coating.

3.9 INSTALLING UNDERGROUND CONDUIT WITHOUT CONCRETE ENCASEMENT

A. Run conduit in straight lines except as necessary.

B. Trenches: At least three inches (80 mm) clearance on each side of the conduit.

C. Warning tape: Install in backfill approximately 12 inches (300 mm) below grade.

D. Under existing roads and paved areas not to be disturbed, jack rigid steel conduit into place.

3.10 SCHEDULE OF LOCATIONS

A. RGS with screw joint couplings:
   1. Conduits in concrete slabs except where noted to be plastic.
   2. First five feet of conduit extending outside building.
   3. Under roads and paved areas where existing pavement is not to be disturbed, extending at least five feet beyond edges of pavement.
   4. Elbows penetrating floor slabs.

B. IMC with screw joint couplings:
   1. Wiring to exterior equipment and where exposed in wash down areas.
   2. Conduits in for fire alarm system and security system.

C. EMT: Sizes 4 inches (102 mm) and smaller except as noted above.

D. Plastic with solvent cement joints:
   1. For exterior circuits, directly buried, except first five feet from building.
   2. Where noted under concrete slab, concrete encased.
   3. Where noted under concrete slab, direct buried.
   4. Where noted in concrete slabs.
   5. For concrete encased duct banks.

END OF SECTION
SECTION 26 05 34 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boxes with covers.

1.2 RELATED SECTIONS

A. Conduits: Section 26 05 33.
B. Access doors: Section 26 05 03.
C. Wiring devices: Section 26 27 26.
D. Outlet boxes where required for special systems: Provided by the equipment manufacturers of the various systems.

1.3 SUBMITTALS

A. Product data: Each type of box included in the project.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

B. Boxes:

1. Appleton/EGS Electrical Group
2. RACO/Hubbell Electrical Products
3. Steel City/Thomas & Betts

2.2 MATERIALS

A. Outlet, switch, and junction boxes:

1. Sheet metal: NEMA OS 1, sherardized or galvanized stamped.
2. Cast-metal, where required for weather-exposed, or exposed locations: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
2.3 BOXES FOR WALLS AND PARTITIONS

A. Outlet boxes in concrete construction: Octagonal, two-piece type, of sufficient depth to keep conduits not closer than 1 inch (25 mm) to surface.

B. Switch and receptacle boxes in masonry partitions and walls: Square cornered tile wall boxes 3.5 inches (90 mm) deep, or four-inch (100-mm) square boxes with raised tile wall device covers. The device covers shall be of extra depths required to suit the block or brick construction in which they are placed.

C. Switch and receptacle boxes in metal stud partitions: 4 inches (100 mm) square by 1.5 inches (38 mm) deep boxes with 0.75-inch (19-mm) raised tile wall device covers finishing flush with finished wall surface.

D. Wall- and partition-mounted outlets for low-voltage systems: Same as specified above for switches and receptacles.

2.4 JUNCTION AND PULL BOXES

A. Junction and pull boxes in feeder conduit runs: Galvanized, of size required for conduit arrangement and not less than the size required by NFPA 70, and furnished with screwed covers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide box at each outlet, switch, and appurtenance. Each box shall be of a type suitable for the duty intended and shall be installed in accordance with the manufacturer’s instructions.

1. Where conduit is weather-exposed or exposed, provide cast-steel or cast-aluminum boxes.

B. Coordinate locations of boxes with installation of conduit as specified in Section 26 05 33.

C. Do not install boxes back-to-back (through the wall) in partitions.

D. Firmly secure the boxes in place, plumb, level, and with front of device cover even with finished wall surface.

E. Boxes in metal stud walls or partitions shall be securely supported by metal channels spanning between two studs and attached to same.
F. Outlet boxes used for supporting lighting fixtures: Furnish with malleable iron fixture studs of “No-Bolt” type, secured by locknut. Provide structural channel supports for boxes occurring in ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction. Special supports for boxes shall be as directed and approved by the Architect.

G. Where service fittings will not permit ganging of boxes, outlets shall be as close as practical.

H. Provide a single cover plate where two or more devices are grouped together in one box.

I. Verify door swings with door frame installed before locating switch outlets.

J. Outlet boxes in fire-rated assembly:
   1. Clearance between boxes and wallboard shall not exceed 0.125 inch (3.2 mm).
   2. Surface area of individual outlet box does not exceed 16 square inches (103 sq cm).
   3. Entire surface area of boxes shall not exceed 100 square inches (645 sq cm) per 100 square feet (9.3 sq m) of wall surface.

3.2 IDENTIFICATION

A. Identification on outside covers of pull and junction boxes in ceiling space or exposed on walls: Paint with colored enamel or mark with permanent waterproof black marker, or both, as specified.
   1. Fire alarm system: Red.
   2. Other special systems: Mark with system type, such as Data or Security.
   3. Power and lighting: Panelboard designation and circuit number(s).

B. Identification inside boxes for recess-mounted or concealed in walls and partitions: Plasticized card stock tags marked with permanent waterproof black markers.
   1. Fire alarm system: Fire alarm.
   2. Other special systems: Mark with system type, such as Data or Security.
   3. Power and lighting: Panelboard designation and circuit number(s).

END OF SECTION
SECTION 26 05 41 - LOW-VOLTAGE SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Service entrance for electric service, 208 V, 3 phase, 4 wires.

1.2 RELATED SECTIONS

A. Temporary power for construction: Division 01.
B. Trenching: Section 26 05 01.
C. Electrical manholes and underground ductbank: Section 26 05 44.
D. Equipment foundations: Section 26 05 28.

1.3 PAYMENT PROCEDURES

A. New electric service will be installed by Delmarva Power Co. (the Power Company).
B. Submit the bill on completion of this part of the work. Owner will directly pay the Power Company.

1.4 SUBMITTALS

A. Product data: Each type of device or equipment required for the installation.
B. Shop drawings: Submit shop drawings and other information as required to the Power Company.
C. Certifications: Copy of certification for installation required by Power Company.

1.5 COORDINATION

A. New electric service will be installed by Delmarva Power Co. (the Power Company). Contact the designated power company service representative and verify the status of the project service application. If the current service application has expired, resubmit the service application using load data from the original application.
B. New communications service(s) will be installed by the telephone company and the cable television company. In coordination with the Owner, contact the service company representative(s) to coordinate installation of the new service(s). Provide necessary underground or above ground conduit/sleeve provisions as required by communication service provider(s).

C. Arrange a project site meeting to verify that the proposed service entrance configuration is acceptable to the service company. Participants of the meeting shall include the service company representative, the Owner, the Contractor and the Architect.

D. Contact “Miss Utility” (1-800-257-7777) prior to any excavation or underground work. The location and depth for all utilities shall be verified. Provide test pits to verify location and depth of all existing utilities crossing new incoming services.

PART 2 - PRODUCTS

2.1 CONDUITS, FITTINGS, AND CONDUCTORS

A. Power Company will provide above ground primary cables, transformers, final tie-ins and meters, as described in the article “Installation by Power Company,” below.

B. Conduits: As specified and scheduled in Section 26 05 33, Conduits.

C. Ductbanks: As specified in Section 26 05 44, Underground Ducts and Utility Structures, and in accordance with Power Company requirements.

D. Fittings: As required by installation and by Power Company requirements, and as specified in Section 26 05 33, Conduits.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate installation with Power Company.

B. Coordinate installation with communications service company.

C. Coordinate installation with installation of gas lines and other underground utilities specified in Divisions 23 and 31.

3.2 INSTALLATION BY POWER COMPANY

A. Primary power from Power Company lines to a point aboveground.

3.3 INSTALLATION INCLUDED IN WORK OF THIS PROJECT
A. Concrete encased ductbank from aboveground power line to power company transformer as indicated on the drawings, minimum 5 inches (127 mm), as specified in Section 26 05 44, Underground Ducts and Utility Structures, including markers or underground warning tape and in accordance with Power Company requirements. Primary power cabling, as specified on drawings, between utility power pole and transformer Pad. Final tie-ins are performed by power company. Provide sufficient slack per power company requirements at both the power pole and transformer.

B. Concrete encased ductbank from transformer to building as indicated on the drawings, minimum 4-inches (102 mm), as specified in Section 26 05 44, Underground Ducts and Utility Structures, including markers or underground warning tape, and in accordance with Power Company requirements. Secondary power cabling, as specified on drawings, between transformer pad and building service entrance panelboard. Final tie-ins at utility transformer are performed by power company. Provide final tie-ins at building service entrance panelboard. Provide sufficient slack per power company requirements at the transformer.

C. Where conduit enters a transformer or meter cabinet, provide bellmouth fittings on conduit ends 2 inches (51 mm) above the concrete slab.

D. Concrete foundation for Power Company transformer: Specified in Section 26 05 28, Equipment Foundations.

E. Handholes as shown on the drawings: Specified in Section 26 05 44, Underground Ducts and Utility Structures.

F. Fence around Power Company transformer: Specified in Division 32.

3.4 TELEPHONE SERVICE INSTALLATION

A. Provide conduit in ductbank for telephone service, as specified in Section 26 05 44. Spacing between conduits shall be no less than 3 inches.

3.5 TELECOMMUNICATIONS SERVICES INSTALLATION

A. Provide conduits in ductbank for telecommunications services, as specified in Section 26 05 44. Spacing between conduits shall be no less than 3 inches.

END OF SECTION
SECTION 26 05 44 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Ducts in directly buried duct banks.
2. Handholes and handhole accessories.

B. Related sections include the following:

1. Section 26 05 26 for grounding electrodes, counterpoise conductors, clamps and connectors for grounding metallic handhole accessories and testing of grounds.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO-HB 17: Standard Specifications for Highway Bridges. Includes the AASHTO categories for structural loads:
   b. Medium traffic: HS15.
   c. Light traffic: H10.

B. Society of Cable Telecommunications Engineers (SCTE):

1. SCTE 77: Specification for Underground Enclosure Integrity. Light duty and pedestrian traffic only. Includes Tiers for specific applications, and static vertical wheel load ratings:
   a. Tier 5: Sidewalk applications with a safety factor for occasional nondeliberate vehicular traffic.
   b. Tier 8: Sidewalk applications with a safety factor for nondeliberate vehicular traffic.
   c. Tier 15: Driveway, parking lot, and off-roadway applications subject to occasional nondeliberate heavy vehicular traffic.

1.3 SUBMITTALS

A. Product data: For the following:
1. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
2. Duct bank materials, including spacers and miscellaneous components.
3. Warning tape.

B. Shop drawings: Show fabrication and installation details for underground ducts and utility structures and include the following:

   1. For precast handholes, shop drawings shall be signed and sealed by a qualified professional engineer, and shall show the following:

      a. Construction of individual segments.
      b. Joint details.
      c. Design calculations.

C. Coordination drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

D. Product certificates: For concrete and steel used in underground precast handholes, according to ASTM C 858.

1.4 QUALITY ASSURANCE

A. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS
A. Existing utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Architect at least two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect’s written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct bank entrances into handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to handholes, and as approved by Architect.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 PRODUCTS AND 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:

1. Nonmetallic ducts and accessories:
   a. ARNCO Corp.
   b. Beck Manufacturing Inc.
   c. Cantex, Inc.
   d. CertainTeed Corp.; Pipe & Plastics Group.
   e. ElecSys, Inc.
   f. Electri-Flex Co.
   g. IPEX, Inc.
   h. Lamson & Sessions; Carlon Electrical Products.
   i. Manhattan/CDT
   j. Spiraduct/AFC Cable Systems, Inc.
2. Precast polymer concrete enclosures for underground construction:
   a. Quazite/Strongwell (Hubbell Power Systems, Inc.).
   b. Synertech (Division of Oldcastle Precast).

2.2 CONDUIT

   A. Conduit and fittings are specified in Section 26 05 33.

2.3 DUCTS

   A. Rigid nonmetallic conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

   B. Rigid nonmetallic conduit: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.4 HANDHOLES

   A. Precast handholes: Reinforced concrete, monolithically poured walls and bottom, with cast-aluminum frame and access door assembly forming the top of handhole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading.

   B. Cover legend: “ELECTRIC” or “COMMUNICATIONS”.

PART 3 - EXECUTION

3.1 APPLICATIONS

   A. Underground ducts for electrical feeders 600 V and below: EPC-40-PVC, concrete-encased duct bank.

   B. Underground ducts for electrical branch circuits 600 V and below: Type EPC-40-PVC, directly buried duct bank, except use Type EPC-80-PVC when crossing roads.

   C. Underground ducts for communication circuits: Type EPC-40-PVC, directly buried duct bank.

   D. Handholes: Underground precast precast polymer concrete enclosures.
3.2 EARTHWORK

A. Excavation and backfill: Comply with Section 26 05 01, Excavation and Fill for Electrical Work, but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Section.

D. Restore disturbed pavement. Refer to “Cutting and Patching” in Section 26 01 01.

3.3 CONDUIT AND DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment.

B. Curves and bends: Use manufactured rigid steel elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet (7.5 m), both horizontally and vertically, at other locations.

C. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer’s written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

D. Duct entrances to handholes: Space end bells approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts and vary proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.

E. Building entrances: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

   1. Waterproofed wall and floor penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

   F. Directly buried ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:
1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts.
2. Install expansion fittings as shown on shop drawings.
3. Trench bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms as specified in Section 260501, Excavation and Fill for Electrical Work.
4. Backfill: Install backfill as specified in 260501, Excavation and Fill for Electrical Work. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally.
5. Minimum clearances between ducts: 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
6. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade, unless otherwise indicated.

G. Warning tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank.

H. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet (1.5 m) from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete.

I. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

J. Pulling cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

3.4 HANDHOLE INSTALLATION

A. Elevation: Install handholes with rooftop at least 15 inches (375 mm) below finished grade. Install handholes with depth as indicated. Where indicated, cast handhole cover frame directly into roof of handhole and set roof surface 1 inch (25 mm) above grade.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated.

C. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
D. Field-installed bolting anchors: Do not drill deeper than 3.875 inches (98 mm) for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

E. Precast concrete handhole installation: Unless otherwise indicated, comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Duct integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

C. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This section includes electrical identification materials and devices required to comply with ANSI, NFPA, and OSHA standards.

B. This section addresses identification of electrical equipment, raceways, boxes, conductors, and other related electrical system components.

1.2 SECTION INCLUDES

A. Identification of power conductors and control cables.

B. Identification of equipment and instructions.

C. Miscellaneous identification products.

1.3 RELATED SECTIONS

A. Sections in Divisions 26 and 28.

1.4 REFERENCES


B. ANSI Z535.4: Standard for Product Safety Signs and Labels.


E. NFPA 70E: Standard for Electrical Safety in the Workplace.


1.5 SUBMITTALS

A. Product data: For each type of electrical identification product.

1.6 QUALITY ASSURANCE


B. Comply with NFPA 70.

C. Comply with OSHA standards.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.7 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other sections requiring identification applications, drawings, shop drawings, manufacturer’s wiring diagrams, and the operation and maintenance manual; and with those required by codes, standards, and safety regulations. Use consistent designations throughout Project.

B. Coordinate installation of identification materials and devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identification materials and devices with location of access panels and doors.

D. Install identifying materials and devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers, or approved equal:

1. Brady USA, Inc.
2. Carlton Industries
3. Graphic Products, Inc.
4. Ideal Industries, Inc.
5. Panduit Corporation
6. Presco
7. Seton Identification Products
8. Thomas & Betts Company
9. Utility Safeguard

2.2 GENERAL PRODUCT REQUIREMENTS

A. Except where otherwise indicated, provide manufacturer’s standard identification products of category and type suitable for each application. Where more than one identification method is specified for an application, the Installer shall select and utilize each material in a consistent manner.

2.3 CONDUCTOR AND CABLING IDENTIFICATION

A. Adhesive labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Color-coded, adhesive tape: Self-adhesive, vinyl tape, in appropriate colors for system voltage and phase.

C. Marker tapes: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

D. Wrap-around marker bands: Diameter sized to suit conductor or cable it identifies.
   1. Plastic, color-coded, pretensioned, grip-type, flexible, acrylic sleeve.

2.4 EQUIPMENT IDENTIFICATION

A. Engraved plastic nameplates: Laminated plastic, engraved, white letters on black background, except where other color schemes are noted or specified.
   1. Size: Minimum 0.75-inch (19 mm) by 2.5-inches (64 mm).
   2. Letter size: Minimum height of 0.375-inch (10 mm).
   3. Mechanically fastened, except adhesive mounted where necessary due to substrate.
      a. Mechanical fastener: Punched or drilled, with vandalproof stainless steel or brass screws or rivets.

B. Baked-enamel signs: Preprinted, aluminum signs, punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.
C. Exterior, metal-backed, signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate (CAB) signs with galvanized steel backing; punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.

D. Adhesive film label: Machine-printed, black letters on white background, through thermal transfer or equivalent process, with clear weatherproof and UV-resistant covering. Minimum letter size height of 0.375-inch (10 mm).

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS


1. Not less than 6-inches wide by 4 mils thick (152 mm wide by 0.102 mm thick).
2. Tape Material:
   a. Made of metal detectable polyester or vinyl.
   b. Compounded for permanent direct-burial service. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to destructive substances commonly found in soils.

3. Printed legend with black lettering, indicating type of underground line.
   a. Provide inscriptions for power cabling with red-colored tape: Example – “CAUTION – BURIED ELECTRIC LINE BELOW”.

B. Wiring device tape labels:

1. Adhesive film label: Machine-printed, black letters on clear background, through thermal transfer or equivalent process. Minimum letter size height of 0.25-inch (6 mm).
   a. Labeling for electrical devices and components such as receptacles, switches, control device stations, manual motor starters, network and phone jacks, junction and pull boxes, etc.

C. Warning labels and signs:

1. Self-adhesive warning labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configures for display on front cover, door, or other access to equipment unless otherwise noted.
2. Baked-enamel warning signs: Preprinted, aluminum signs, punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.
3. Fasteners: Self-tapping, stainless-steel screws or, stainless-steel machine screws with nuts, flat and lock washers.

D. Tape markers: Vinyl, pressure-sensitive, with clear vinyl overlay.

1. Working space, floor markers: Minimum 2-inch (50 mm) wide, 5 mil (0.125 mm) thick, with black and yellow stripes.

E. Cable ties: Fungus-inert, self-extinguishing, one-piece, self-locking, color-coded, nylon cable ties suitable for the application (general purpose, UV-stabilized outdoor, or plenum rated).

F. Paint: Formulated for the type of surface, location, and intended use.

G. Stenciling: Nonfading, waterproof, ink or paint. Black or color-coded.

H. Adhesive: Heavy-duty, thermo-resistant, industrial grade adhesive, for adhesion to any surface without identification curling, peeling, or falling off.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification products at locations for most convenient viewing without interference with operation and maintenance of equipment.

1. For finished public spaces, coordinate identification product mounting locations with Architect.

C. Apply identification products to surfaces after equipment finish work has been completed.

D. Clean surfaces before applying identification products, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Cable ties: For attaching tags, use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In spaces handling environmental air: Plenum rated.
G. Underground-line warning tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16-inches (400 mm) overall.

H. Painted identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 APPLICATION

A. Miscellaneous:

1. Access doors and panels: Apply engraved nameplate labels at access doors identifying concealed electrical item. Do not locate labels in finished, public spaces.

2. Arc flash warning labels: Refer to Section 26 05 73, Overcurrent Protective Device Studies, for arc flash labeling requirements.

B. Junction and pull boxes:

1. Label each junction and pull box, identifying circuit designation or type of system.
   a. Exposed boxes: Place label on coverplate, externally visible.
   b. Concealed boxes: Place label or tag on inside cover of box.
   c. Junction boxes concealed above suspended ceilings or exposed in non-occupied spaces may be marked with permanent ink marker in lieu of printed labels.

2. Fire alarm system boxes shall have red finish. Boxes shall be prefinished prior to installation.

C. Wiring and cabling identification:

1. Power circuit conductor identification, 600 V or less: Apply color-coded identification for cables, feeders, and power circuit conductors exposed in accessible vaults, junction and pull boxes, utility structures, and equipment enclosures. Apply color-coding scheme as indicated below throughout the building’s network of feeders and circuits, unless otherwise required by the authority having jurisdiction.
   a. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
   b. Colors on conductors No. 8 and larger, or No. 4 and larger for grounded and grounding conductors: Apply colored tape wrapped a minimum of 6 inches (150 mm) on either end of conductor and in boxes where splices or taps are made.
   c. Conductors used solely for grounding purposes shall be green, if insulated.
IDENTIFICATION FOR ELECTRICAL SYSTEMS  

Brandywine Zoo  
QUARANTINE SUPPORT BUILDING  
June 2, 2020

DIVISION OF PARKS AND RECREATION  
PROJECT NO. WBZ-9

COLOR CODE (600 V Max.)

<table>
<thead>
<tr>
<th>VOLTAGE</th>
<th>NEUTRAL</th>
<th>PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>120-V, 2-wire</td>
<td>White</td>
<td>Black or Red, depending on phase</td>
</tr>
<tr>
<td>240/120-V, single phase, 3-wire</td>
<td>White</td>
<td>Black</td>
</tr>
</tbody>
</table>

2. Power circuit conductor identification, greater than 600 V: Apply nonmetallic tags or aluminum, wraparound marker bands where cables, feeders, and power circuits are exposed in vaults, junction boxes, and utility structures. Apply securely fastened legend identifying circuit or feeder designation.

3. Conductors for future use: Attach tags with circuit designation for conductors to be extended for future use.

4. Control and low-voltage system wiring shall be coded with colors and markings different from those used to designate phase wires.

D. Wiring device labels: For wiring devices such as receptacles and other wiring devices operating at or greater than 120V.

1. Apply adhesive film labels on inside of wiring device coverplates identifying circuit designation serving device.

2. Apply adhesive film labels on outside of wiring device coverplates identifying circuit designation serving device, except apply on the inside cover for the following locations.

   a. Public areas.

3. For special receptacle configurations, apply label identifying applicable device NEMA configuration designation in location not concealed by plug.

E. Equipment Identification: Install unique designation label consistent with contract documents and shop drawings.

1. Labeling instructions:

   a. Engraved plastic laminate nameplates, unless otherwise indicated.

   b. Unless otherwise required, provide a single line of text with 0.5-inch (13 mm) high lettering on 1.5-inch (38 mm) high label. Where two or more lines are required, use single label with increased height.

   c. For multi-section or multi-compartment equipment, apply labels identifying each compartment or section.

   d. For fusible equipment, identify fuse type and size on the front cover.

   e. For enclosed circuit breaker equipment, identify device trip rating where rating is not visible.

   f. Where equipment has more than one source of power (i.e., transfer switch, separate control power source), the location and circuit designation of each power source shall be clearly identified at the equipment location.
2. Apply nameplates and labels to equipment according to the below identification schemes:

   a. Identify equipment designation; voltage rating; phase and number of wires; and designation and location of load served. Apply products to the following equipment:

      (1) Panelboards

   b. Identify equipment designation; primary and secondary voltage ratings; phase and number of wires; circuit designation and location of primary source; and designation and location of load served. Apply products to the following equipment:

      (1) Disconnect switches
      (2) Enclosed circuit breakers
      (3) Motor starters

   c. Identify equipment designation; voltage rating; phase and number of wires; and capacity rating. Apply products to the following equipment:

      (1) Generator: Capacity rating in kilowatts (kW).
      (2) Transfer switches: Capacity rating in amperes; identify the location and circuit designation of each power source at the equipment location.

   d. Identify equipment designation; and circuit designation and location of primary source. Apply products to the following equipment:

      (1) Fire alarm control panels and auxiliary equipment

3. Nameplates shall incorporate white lettering on colored backgrounds based on the following color-coding scheme:

   a. Normal power system: Black background.

F. Working space requirements: Identify required working clearances at electrical equipment. Working clearance dimensions shall be in compliance with NFPA 70 and OSHA regulations.

   1. Working space labels, markers, and signs: Apply permanent labels, markers, or signs at the following locations with appropriate message indicating required working clearances.
a. Apply identification products to electrical equipment installed in unfinished spaces such as mechanical, electrical, and storage rooms. Do not install identification products at equipment installed in finished or public spaces unless otherwise indicated.

b. Apply floor marking tape or paint on the floor to clearly show required working clearances.

c. Electrical distribution equipment including the following: Panelboards.

G. Warning and caution labels and signs:

1. Apply warning and caution labels on equipment in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements including arc flash hazard warning labels and special clearance requirements.

2. Apply warning and caution labels and signs at locations where safe operation and maintenance of electrical system equipment is of concern.

3. Apply warning signs on electrical room doors in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements. Where doors are located in finished, public areas, located sign on the inside of the door. Coordinate mounting requirements with door type.

H. Service-entrance equipment: Provide field marking of service entrance equipment maximum available fault current values in accordance with NFPA 70 requirements.

I. Underground warning tape: Apply underground warning tape above underground ductbanks, conduit, or direct-buried cable.

3.3 FIELD QUALITY CONTROL

A. Coordinate names, abbreviations, colors, and other designations with construction documents, submittals, and applicable code and standards requirements. Utilize consistent designations and identification techniques throughout project.

B. Install identification products at locations that are clearly visible at normal viewing angles and without interference with operation and maintenance of the equipment.

C. Install identification products in a neat and clean, workmanship-like manner where products are securely attached and oriented parallel to equipment edges.

END OF SECTION
SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE STUDIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical system fault-current and protective device study:
   1. Fault-current analysis.
   2. Coordination study and device settings.
   3. Arc flash hazard analysis.

1.2 RELATED SECTIONS

A. Sections in Division 26.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE):

B. American National Standards Institute (ANSI):
   1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

C. National Fire Protection Association (NFPA):

D. Occupational Safety and Health Administration (OSHA):


1.4 SUBMITTALS

A. Product data: For computer software to be used to perform studies.

B. Product certificates: For coordination-study and fault-current analysis computer software programs, certifying compliance with IEEE 399.

C. Qualifications:

1. Submit evidence indicating individual and organization compliance with requirements indicated in “Quality Assurance” below.

D. Preliminary electrical system study: Submit for review before distribution equipment shop drawings have been submitted, and before equipment order has been released to the manufacturer.

1. If formal completion of the study may delay the project schedule, Architect/Engineer or Owner may approve use of the preliminary draft for ordering equipment.
2. If approved for use in ordering equipment, preliminary draft shall include sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

E. Final electrical system study:

1. Submit final report for review and record.
2. Incorporate changes resulting from deficiencies and corrections of preliminary draft report.

F. Reports:

1. Electrical system study report: Submit reports required above including the following items:

   a. General report information: Scope, definitions, descriptions, assumptions, and other information necessary to properly interpret results of the report.
   b. Tabulated summary comparing protective device ratings and calculated available fault-current levels.
c. Tabulated summary of protective device settings including circuit breaker, fuse, and relays.
d. Fault-current analysis calculations.
e. Selective coordination study overlay, plots of device time-current curves and relationship to other distribution system components.
f. Arc flash hazard calculations including details of the incident energy and flash protection boundary calculations.
g. Tabulated summary of values associated with load flow study.
h. Tabulated summary of values associated with voltage drop analysis.
i. Recommendations for system improvements.
j. System one-line diagram.
k. Input and output data used for each component and for study calculations.

2. Submit final reports as electronic files in portable document format (.pdf) to Owner. Submit program base files in file format of computer software utilized to perform study.

1.5 QUALITY ASSURANCE

A. Electrical system study shall be performed by one or more independent qualified organizations, and under the supervision and approval of a Registered Professional Engineer skilled in performing and interpreting the power system studies.

B. Qualifications of organization performing electrical system study: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices:

1. Registered Professional Engineer shall be a full-time employee of the equipment manufacturer or of an approved engineering firm.
2. Registered Professional Engineer shall have a minimum of five (5) years of experience in performing power system studies and registered in the state where the project is located.

C. Qualifications of computer based software: Widely available, complying with standards, guides, and codes as referenced above.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Computer software: Subject to compliance with requirements, utilize product by one of the following:

1. EDSA Micro Corporation
2. Operation Technology, Inc.
3. SKM Systems Analysis, Inc. (Basis of Design)

2.2 COMPUTER SOFTWARE REQUIREMENTS

A. Comply with IEEE 399.

B. Computer software program shall be capable of performing fault-current analysis of project electrical distribution system.

C. Computer software program shall be capable of plotting and diagramming time-current characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

D. Computer software program shall be capable of performing arc fault hazard analysis using equations as established by IEEE 1584 and requirements presented in NFPA 70E, Annex D.

E. Software shall include a comprehensive equipment library of manufacturer-based and IEEE / ANSI based equipment to accurately model the electrical distribution system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine project submittals for compliance with electrical distribution system requirements outlined on the drawings and in electrical specification sections.

3.2 SYSTEM DATA COLLECTION

A. The Contractor shall furnish all data required to perform the power system studies. The Engineer performing the fault analysis, protective device coordination, and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to ensure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. If applicable, include fault contribution of existing motors and equipment in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.
C. The Engineer performing the studies shall gather and tabulate input data necessary to support each study including the following:

1. Product data for each component of the electrical distribution system.
2. Utility available fault contribution and impedance values.
3. Drawings, one-line, and riser diagrams showing system configuration, equipment designations, feeder lengths, and other applicable system characteristics.

3.3 SYSTEM FAULT CURRENT ANALYSIS

A. Calculate the maximum available short-circuit momentary current and interrupting duties in amperes rms symmetrical for electrical power distribution system components. The calculation shall be performed for current immediately after initiation and for a three-phase bolted fault at each of the following locations:

1. Distribution panelboards.
2. Branch circuit panelboards.
3. Generator output terminals.
5. Variable frequency drives serving motors equal to or greater than 25 horsepower.

B. Study the project’s electrical distribution system from normal and alternate power sources throughout electrical distribution system.

C. For grounded systems, provide line-to-ground fault current values for areas as defined above for the three-phase, bolted fault, short-circuit study.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.

E. Study Report:

1. Input data: Gather and provide the following input data, in tabular or graphic form, used to perform fault calculations and other studies in this section.

   a. Utility three-phase and line-to-ground available contribution with associated X/R ratios.
   b. Short-circuit reactance of rotating machines with associated X/R ratios.
   c. Cable type, construction, size, quantity per phase, length, impedance and conduit type.
   d. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.
   e. Circuit breaker types and sizes.
2. Methods and assumptions: Indicate calculation methods and assumptions that may have been used to perform analysis.

3. Results: Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram. Provide the following in a table format:

   a. Source fault impedance and generator contributions
   b. X/R ratios
   c. Asymmetry factors
   d. Motor contributions
   e. Short circuit KVA
   f. Symmetrical and asymmetrical fault currents

4. Equipment evaluation and conclusions:

   a. Verify interrupting ratings and withstand ratings are equal to or higher than calculated fault current levels.
   b. Verify adequacy of phase conductors at maximum three-phase, bolted fault currents.


3.4 SYSTEM COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written and graphical report using results of fault current study and proposed protective devices and system distribution components. Comply with IEEE 399.

B. Coordination curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series using time-current curves plotted on log-log scale graphs.

C. Prepare separate sets of curves to demonstrate full system coordination. Include the following equipment on plotted coordination curves:

   1. Low-voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands.
   2. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
   3. Conductor damage curves.
   4. Significant motor starting characteristics and motor damage points.
   5. Significant generator short-circuit decrement curve and generator damage point.

D. Recommended device settings: Prepare a tabulated summary of recommended device settings for system adjustable protective devices. Include the following information:

1. Device tags.
2. Circuit breakers:
   a. Sensor and plug ratings, where applicable.
   b. Adjustable pickups and time delays (long time, short time, ground)
   c. Adjustable time-current characteristic
   d. Adjustable instantaneous pickup
   e. Recommendations for improved system coordination

3. Fuses:
   a. Current rating
   b. Type

3.5 SYSTEM ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (such as panelboards) where work could be performed on energized parts.

C. The arc flash hazard analysis shall include electrical equipment locations where work such as examination, adjustment, service, or maintenance could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering incident energy of 1.2 cal/cm².

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that
the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off).

1. Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

L. Incident energy and flash protection boundary calculations:

1. Arcing fault magnitude
2. Device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

3.6 ARC FLASH WARNING LABELS

A. The Contractor and organization performing the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance
7. Engineering report number, revision number and issue date

D. Labels shall be machine printed, with no field markings.

E. Labels shall be in compliance with NFPA 70E and OSHA standards.

F. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 208V panelboard, one arc flash label shall be provided.

3.7 FIELD QUALITY CONTROL

A. Field Adjustment: Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
C. Notify Architect in writing of any required equipment modifications.

END OF SECTION
SECTION 26 09 23 - STAND-ALONE LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.11 SECTION INCLUDES

A. Switches.
B. Occupancy sensors.
C. Lighting contactors.
D. Time-based control devices.

1.14 RELATED SECTIONS

A. Identification: Section 26 05 53.
B. Modular lighting controls: Section 26 09 36.
C. Interior lighting: Section 26 51 00.
D. Exterior lighting: Section 26 56 00.

1.20 REFERENCES


1.30 SUBMITTALS

A. Product data: Each type of device used in the project.
B. Bill of materials: Provide detailed list of components and quantities.
C. Shop drawings: Detail assemblies of standard and project specific components. Indicate dimensions and arrangement of components.
   1. Floor plans: Identify locations of lighting control system components; interconnection of components. Utilize reflected ceiling plans to show location, orientation, and coverage area of sensors.
2. Wiring diagrams: Power, signal, and control wiring, differentiating between manufacturer-installed and field-installed wiring, provided on a schematic diagram.
3. Include representative views of components, including button layouts, engraving, colors, and other physical characteristics pertinent to each device.

D. Field quality control test reports.

E. Qualifications of factory certified field service engineer.

F. Operation and maintenance data: For lighting control system and associated components, provide product data, shop drawings, and test reports in operation and maintenance manual. In addition to items specified in Division 01, include list of replacement parts and assemblies.

1.40 QUALITY ASSURANCE

A. Devices shall be UL listed and labeled for their intended application.

B. Provide services from factory certified field service engineer to perform functional testing.

C. Qualifications for factory certified field service engineer:
   1. Minimum experience of 2 years training in the electrical/electronic field.
   2. Certified by the equipment manufacturer on the system installed.

1.50 DELIVERY, STORAGE, AND HANDLING

A. Store components indoors in a clean dry space with uniform temperature to prevent condensation. Protect switches from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 - PRODUCTS

2.20 SWITCHES

A. Manufacturers:
   1. Pass & Seymour/Legrand (basis-of-design).
   2. Leviton Manufacturing Co.
   3. Hubbell/Bryant Electric.
   4. Cooper Industries/Cooper Wiring Devices.

B. Provide devices conforming to UL 20, equal to the following P&S catalog numbers:
1. Switches: PS20AC1, PS20AC3 (3-way), PS20AC4 (4-way).
2. Switches, weatherproof: PS20AC1, PS20AC3 (3-way), PS20AC4 (4-way), with CA1-GL cover.

C. Device color: White.

D. Device plates: Equal to Pass & Seymour, Type 302 stainless steel, SS Series.

2.21 OCCUPANCY SENSORS

A. Basis-of-design product: Subject to compliance with requirements, provide products manufactured by Eaton/Cooper Controls, Greengate series, or comparable product that includes but is not limited to one of the following:

1. Acuity Brands/Sensor Switch/nLight
2. Eaton/Cooper Controls
3. WattStopper/Legrand

B. Sensor types:

1. Wall switch occupancy sensor: Wired, 120/277V dual-input, dual-technology sensor, combination ultrasonic/passive infrared detector with override switch, capable of installation in a standard wall switch backbox.
   a. On-off type: Equal to Wattstopper (Legrand), Model DW-100.
   b. Manual-on, 0-10 volt dimming type: Equal to Wattstopper (Legrand), Model DW-311.

2. Ceiling-mounted occupancy sensor: Wired, dual-technology sensor, combination ultrasonic/passive infrared detector capable of installation in acoustic ceiling tile or gypsum ceiling. Detector shall provide 360-degree, 2000 square feet coverage.
   a. Low voltage: Rated at 24 input voltage, 60 hertz, with power pack and low-voltage wiring per manufacturer's requirements.

C. Auxiliary components:

1. Power pack: Universal 120/277V switched input, controlled through a high-current 20A relay. Low voltage output, less than or equal to 24VDC, for powering low voltage occupancy sensors. Enclosure shall be plenum rated.
2. Override switch: Low-voltage switch shall operate on voltage less than or equal to 24VDC and shall have a momentary contact actuator to send a signal to the associated power pack to change the current lighting state. Color shall match switch device color specified above.
D. Ultrasonic detector: Volumetric sound wave at 40 kHz. Frequency. Detector shall automatically adjust detection threshold to compensate for learned environmental behavior.

E. Infrared detector: Passive, with field-adjustable ambient light adjustment.

F. Dual-technology detector: Includes both infrared and ultrasonic detectors.

G. Indicator: LED positive detection.

H. Adjustable delayed off-time range: Between 30 seconds and 15 minutes, factory set to 15 minutes.

I. Fail on: Lights will go to full brightness if sensor fails.

2.22 LIGHTING CONTACTORS

A. Lighting contactors: Equal to Square D 8903, UL 508 listed, in NEMA 250 Type 1 enclosure, mechanically held, electrically operated, enclosed silver-alloy double-break contacts, coil-clearing contacts; withstand rating as indicated on the drawings; Hand/Off/Auto selector switch on cover.

1. Provide contactor with two-wire control relay for two-wire control of mechanically held lighting contactor.

2.23 TIME-BASED CONTROL DEVICES

A. In-wall timer: Solid-state interval timer with manually operated toggle switch for installation in a 2.5-inch deep single-gang or multi-gang wall box, 120/277-volt input, 6-amp rated contacts, flicker warning before timing out, complete with properly marked cover plate. Time cycle adjustable from 15 minutes to 12 hours and set at 8 hours.

1. Single-pole type: Equal to Wattstopper (Legrand), Model TS-400-A, with minimum 1,200-watt load at 277 volts (6 amps).
2. Three-way type: Equal to Wattstopper (Legrand), Model TS-400-A, with minimum 1,200-watt load at 277 volts (6 amps).

B. Digital timeclock: Equal to TORK/NSi Industries, catalog number EWZ201, UL 917 listed, electronic 7-day time switch, microprocessor-based, solid-state, two-channel control, with LCD display and automatic tracking of sunrise and sunset times in order to automatically turn lights ON at sunset and OFF at sunrise.

1. Input voltage: 120-277 volts AC.
2. Output dry contacts: 30 amps at 120 volts AC; 20 amps at 277 volts AC.
3. Scheduling: Twenty ON and OFF set points, capable of different schedules each day of the week.
4. Sunset astronomic: Adjusts daily to changes in sunset times. Adjustable from 10 to 60 degrees, northern or southern latitudes. Can be individually offset plus/minus 1-240 minutes from both sunset and sunrise times.
7. Manual override: Until the next regularly scheduled ON or OFF, automatic operation then resumes.
8. Clock format: AM/PM.
10. Enclosure: Polycarbonate indoor/outdoor NEMA 250 Type 3R with lockable hasp.

2.30 CONDUCTORS AND CABLES

A. Wiring to supply side of remote-control power sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519, Wires and Cables.

B. Low-voltage control cable: Manufacturer's standard multi-conductor cable with stranded-copper conductors not smaller than No. 22 AWG, plenum rated.
   1. Class 2 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.
   2. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 14 AWG.

C. Digital UTP cabling: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5E for horizontal copper cable.

2.40 DEVICE PROGRAMMING REQUIREMENTS

A. Programming of lighting controls shall be performed by a factory certified field service engineer. Refer to Lighting Control Schemes on contract drawings.

PART 3 - EXECUTION

3.20 INSTALLATION, GENERAL

A. Install devices in complete compliance with the manufacturer's recommendations.

B. Provide a single cover plate where two or more devices are grouped together in one box.
C. Verify door swings with door frame installed prior to rough-in for switches.

D. Ground components according to Section 26 05 26, Grounding and Bonding.

E. Fully document control device calibration settings after system programming with manufacturer's representative and submit this information as a part of the O&M manual.

F. Devices shall be installed and programmed to meet the control intent.

G. Manufacturer's factory certified field service engineer shall provide start-up service, including physical inspection of lighting control system and connected wiring and final adjustments to meet specified performance requirements.

3.21 INSTALLING OCCUPANCY SENSORS

A. Install in accordance with manufacturer's written instructions.

B. Provide line voltage type detectors when a single wall device controls lighting within a single space.

C. Provide low voltage type detectors when ceiling detector(s) controls a single space.

D. Coverage pattern: Verify coverage pattern of single detector or system of detectors to be capable of complete coverage of the space in which the lighting is intended to be controlled. Provide additional detectors as necessary to satisfy complete coverage.

E. Programming requirements:
   1. Vacancy mode (manual on, automatic off).
   2. Occupancy mode (automatic on, automatic off).

3.59 IDENTIFICATION

A. Materials: Refer to Section 26 05 53, "Identification for Electrical Systems." Identify devices and wiring.

B. Control stations:
   1. Custom engraving: Provide custom engraving on each button of each control station, defining button’s function. Coordinate with owner for final approval of engraving.

3.60 FIELD QUALITY CONTROL
A. Manufacturer's field service: Engage a factory certified field service engineer to test and inspect components, assemblies, and equipment installations, including connections.

B. Functional testing. Perform tests and prepare test reports for the following:

1. For occupancy sensors, confirm that the placement, sensitivity, and time-out settings are optimized to ensure lights turn off only after each space is vacated and do not turn on unless the space is occupied.

END OF SECTION
SECTION 26 09 32 - TUNABLE WHITE LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Tunable white lighting control power supplies.

B. Tunable white lighting control stations (low-voltage digital wall switches).

C. Conductors and cables.

D. Cost of system startup and testing shall be included in contract sum.

1.2 RELATED SECTIONS

A. Identification: Section 26 05 53.

B. Interior lighting: Section 26 51 00.

1.3 REFERENCES


1.4 DESIGN REQUIREMENTS

A. The lighting control must meet the mandatory control requirements as defined in IECC 2015 energy code.

1.5 PERFORMANCE REQUIREMENTS

A. Provide a complete, non-networked tunable white digital lighting control system. Lighting control system shall include equipment necessary for the proper operation and program of the lighting control system including power supplies, control stations, sensors, and other interfaces.

B. System shall be able to meet the functionality and sequence of operation(s) as listed on the Drawings.

C. Tunable white systems shall be capable of color and intensity control via time based schedule.
1.6 SUBMITTALS

A. Product data: Include manufacturer’s technical product datasheet for each system component including assembly ratings and dimensioned plans, sections, and elevations showing minimum clearances, cable termination sizes, conductor entry, gutter space, installed features, where applicable.

B. Bill of materials: Provide detailed list of components and quantities.

C. Shop drawings: Detail assemblies of standard and project specific components. Indicate dimensions and arrangement of components.
   1. Floor plans: Identify locations of lighting control system components; interconnection of components. Utilize reflected ceiling plans to show the following:
      a. Location, orientation, and coverage area of sensors.
      b. Locations of power supplies and lighting control stations.
   2. Summary list of control devices, sensors, and other loads.
   3. Wiring diagrams: Power, signal, and control wiring, differentiating between manufacturer-installed and field-installed wiring, provided on a schematic diagram.
   4. Include representative views of components, including button layouts, engraving, colors, and other physical characteristics pertinent to each device.
   5. Load schedules: Indicate connected load, load type, and voltage per circuit, circuits and their respective capacity, phase, and corresponding circuit numbers.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Qualifications of factory certified field service engineer.

G. Operation and maintenance data: For lighting control system and associated components, provide product data, shop drawings, and test reports in operation and maintenance manual. In addition to items specified in Division 01, include the following:
   1. List of replacement parts and assemblies.

1.7 QUALITY ASSURANCE

A. System components shall be UL listed and labeled for their intended application.

B. Provide services from factory certified field service engineer to perform functional testing.
C. Qualifications for factory certified field service engineer:
   1. Minimum experience of 2 years training in the electrical/electronic field.
   2. Certified by the equipment manufacturer on the system installed.

D. Obtain lighting controls system components from a single source with total responsibility for compatibility of lighting control system components and lighting fixtures.

E. Lighting control system installation shall comply with NFPA 70.

F. Technical support:
   1. Onsite support: Manufacturer’s authorized service and maintenance representative characteristics shall include the following:
      a. Located in the Wilmington, DE metropolitan area.
      b. Staff is factory employed and trained.
      c. Service available 24 hours a day, seven days a week, 365 days a year.
      d. Maintains an adequate stock of manufacturer’s genuine or approved parts to service this equipment.
      e. Service and maintenance contracts available.
   2. Phone support: Toll free technical support shall be available.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver or install equipment until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, work above equipment 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. Store components indoors in a clean dry space with uniform temperature to prevent condensation. Protect switches from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.9 PROJECT CONDITIONS

A. Environmental conditions: Lighting control system components shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   1. Ambient temperature: 0 to 40 degrees C.
   2. Relative humidity: 5 to 90 percent, non-condensing.
1.10 WARRANTY

A. Special warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of lighting control system and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty period: Two years from date of substantial completion.
2. Warranty shall include parts and labor with no deductible.
3. Warranty shall begin at the date the equipment is accepted by the Owner.

B. Warranty service: Qualified personnel shall be available to repair or replace components of lighting control system and associated auxiliary components that fail in materials or workmanship. Furnish Owner with a telephone number where service representative can be reached at all times. Service personnel shall be at the site within 48 hours after receiving a request for service, and shall restore the lighting control system to proper operating condition within 72 hours.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged in protective box or covering for storage and identified with labels describing contents.

1. Lighting control stations (low-voltage digital wall switches): Three (3).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide products manufactured by Finelite, FineTune Tunable White control system, or comparable product including but not limited to one of the following:

1. Acuity Brands Lighting, Inc., nLight nTune Tunable White (basis-of-design).
2. Eaton/Cooper Controls Room Controller.

2.2 SYSTEM REQUIREMENTS

A. General system operation:

1. System shall be capable of receiving input signals from lighting control stations.
2. Each input and controlled device shall be connected to associated power supply via low-voltage signal cabling.

B. System shall comply with UL standards including UL 916.
C. System requirements:

1. Power failure: The lighting control operations shall resume following a power outage to the pre-outage state.
2. Remote programming.

2.3 TUNABLE WHITE LIGHTING CONTROL POWER SUPPLIES

A. Product: Equal to FineTUNE 0-10V Layer Packs.

1. 0.5-inch chase nipple for mounting through 0.5-inch knockout of junction box.
2. Four RJ-45 communications ports.
3. Operating voltage: 120/277 volts AC.
4. Programming Interface: Bluetooth programming via Android, MacOS, and/or Windows operating systems. Provide necessary programming software/components as part of installation.

2.4 TUNABLE WHITE LIGHTING CONTROL STATIONS

A. Product: Equal to FineTUNE FTCS-SWITCH-M-PWR lighting control station.

1. Mounted in single-gang switch box.
2. One RJ-45 communications ports.
4. Button description: Two-button configuration as follows:
   a. ON: Turns on lighting in room.
   b. OFF: Turns off lighting in room.

B. Product: Equal to FineTUNE FTC-S-CS-TW-S01-L04-W lighting control station.

1. Mounted in two-gang switch box.
2. Minimum One RJ-45 communications ports.
4. Button description: Eight-button configuration as follows:
   a. Scene Selector: Manufacturer’s default scene selection
   b. ON: Turns on lighting in room.
   c. OFF: Turns off lighting in room.
   d. Intensity Slider: Adjusts intensity of light fixtures.
   e. Color Temperature Slider: Adjusts color temperature of tunable white light fixtures.
   f. Return to Schedule Button: Button for control system to resume pre-programmed tunable white schedule.

C. Functionality: Lighting control station(s) shall provide an immediate local LED illumination response upon button activation to indicate that a system command has been
requested. LED will remain lit contingent upon receiving system confirmation of the successful completion of the command.

D. Device finish: White, with matching device plate.

1. Device plate shall be manufacturer’s recommended switch plate.

2.5 CONDUCTORS AND CABLES

A. Wiring to supply side of remote-control power sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19, Wires and Cables.

B. Low-voltage control cable: Manufacturer’s standard multi-conductor cable with stranded-copper conductors not smaller than No. 22 AWG, plenum rated.

1. Class 2 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.
2. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 14 AWG.

C. Digital UTP cabling: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5E or Category 6 for horizontal copper cable.

2.6 DEVICE PROGRAMMING REQUIREMENTS

A. Programming of lighting controls shall be performed by a factory certified field service engineer. Refer to lighting controls diagrams on the Drawings.

2.7 SOURCE QUALITY CONTROL

A. Perform full-function testing on 100 percent of system components and panel assemblies at the factory.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install devices in complete compliance with the manufacturer’s recommendations.

B. Ground components according to Section 26 05 26, Grounding and Bonding.

C. Fully document control device calibration settings after system programming with manufacturer’s representative and submit this information as a part of the O&M manual.

D. Devices shall be installed and programmed to meet the control intent.
E. Manufacturer's factory certified field service engineer shall perform start-up service, including physical inspection of lighting control system and connected wiring and final adjustments to meet specified performance requirements.

3.2 INSTALLING TUNABLE WHITE CONTROLLER POWER SUPPLIES

A. Power supplies shall be surface mounted in accessible ceiling space above entry door.

B. Provide identification of ceiling grid below power supplies to locate device.

3.3 INSTALLING TUNABLE WHITE LIGHTING CONTROL STATIONS

A. Verify door swings with door frame installed prior to rough-in for lighting control stations.

3.4 IDENTIFICATION

A. Materials: Refer to Section 26 05 53, "Identification for Electrical Systems." Identify devices, wiring, and ceiling grid below locations of power supplies.

B. Lighting control stations: Provide engraving on each button of each control station, defining button’s function.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's field service: Engage a factory certified field service engineer to test and inspect components, assemblies, and equipment installations, including connections.

B. Engage a factory certified field service engineer to make site visits indicated to ensure proper system installation and operation. Visit duration shall be suitable to accomplish required tasks.

C. First visit (Pre-installation): Make first visit prior to installation of wiring for lighting control system.

1. Review:
   a. Low-voltage wiring requirements.
   b. Separation of power and low-voltage/data wiring.
   c. Wire labeling.
   d. Power supply locations.
   e. Lighting control station locations.
   f. Load circuit wiring.
   g. Installer responsibilities.
h. Additional manufacturer installation requirements.

D. Completion of installation and programming: Make visits upon completion of installation of the lighting control system. Perform the following tests and inspections:

1. Wiring and hardware review: Wiring connections and electrical equipment included in the scope of the lighting control system shall be assessed.
2. Field testing:
   a. Verify connections to sensors and lighting control stations.
   b. Ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the contract documents and manufacturer's installation instructions.
   c. For occupancy sensors, confirm that the placement, sensitivity, and time-out settings are optimized to ensure lights turn off only after each space is vacated and do not turn on unless the space is occupied.
3. Tuning: Coordinate with factory certified field service engineer an on-site meeting with the Owner and Architect to make required adjustments to the lighting control system for conformance with the original design intent.
4. Operational test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. On-site training: Make two visits for on-site training as described under Article 3.81, Operating Instructions.

G. Lighting control components shall be considered defective if they do not pass tests and inspections.

H. Prepare test reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 SYSTEM STARTUP

A. Upon completion of project, engage a manufacturer's certified field service engineer to perform startup service.

1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
2. Complete installation and startup checks according to manufacturer's written instructions.
3. Program and configure tunable white system to match owner’s requested color tuning preferences. Either install or instruct the owner on installing the programming software on Owner’s devices for future reprogramming.

3.8 OPERATING INSTRUCTIONS

A. As specified in Section 26 05 00, "Common Work Results for Electrical", provide operating instructions.

B. Engage a factory certified field service engineer to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

C. On-site technical training:
   1. Provide at least two sessions of four consecutive training hours of instruction time.
   2. Train Owner's facility management and maintenance personnel, and selected Owner representatives.
   3. Training shall include, but not be limited to, overview, adjustment, operation, use, maintenance, and demonstration of the lighting control system.
   4. The first training session shall occur within one month of substantial completion. The second training session shall be scheduled between 6 months and 9 months of substantial completion.
   5. Each training session shall include on-site demonstration of lighting control system functionality with the Owner.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 26 09 36 - MODULAR LIGHTING CONTROLS

PART 1 - GENERAL

1.11 SECTION INCLUDES

A. Lighting relay room controllers (0-10V dimming relay controllers).
B. Lighting control stations (low-voltage digital wall switches).
C. Occupancy sensors.
D. Daylight sensors.
E. Power supplies and interface devices.
F. Other communications and interfaces.
G. Cost of system startup and testing shall be included in contract sum.

1.14 RELATED SECTIONS

A. Identification: Section 26 05 53.
B. Stand-alone lighting control devices: 26 09 23.
C. Interior lighting: Section 26 51 00.
D. Mechanical system controls: Division 23.

1.20 REFERENCES

D. UL 924: Emergency Lighting and Power Equipment.

1.21 DEFINITIONS

A. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.
B. Zone: A fixture or group of fixtures controlled simultaneously by a single dimmer/relay.

1.26 DESIGN REQUIREMENTS

A. The lighting control must meet the mandatory control requirements as defined in IECC 2018 energy code.

1.27 PERFORMANCE REQUIREMENTS

A. Provide a complete, digital lighting control system. Lighting control system shall include equipment necessary for the proper operation and program of the lighting control system including 0-10V dimming relay controllers, control stations, sensors, and other interfaces.

B. System shall be able to meet the functionality and sequence of operation(s) as listed on the Drawings.

C. Each 0-10V dimming relay shall be individually controllable and shall include on-off, fade, dimming, scene settings, and other control functions to meet designated sequence of operation(s).

1.30 SUBMITTALS

A. Product data: Include manufacturer’s technical product datasheet for each system component including assembly ratings and dimensioned plans, sections, and elevations showing minimum clearances, cable termination sizes, conductor entry, gutter space, installed features, where applicable.

B. Bill of materials: Provide detailed list of components and quantities.

C. Shop drawings: Detail assemblies of standard and project specific components. Indicate dimensions and arrangement of components.

1. Floor plans: Identify locations of lighting control system components; interconnection of components. Utilize reflected ceiling plans to show the following:
   a. Location, orientation, and coverage area of sensors.
   b. Locations of lighting relay room controllers and lighting control stations.

2. Provide summary list of control devices, sensors, other loads, and interface devices.

3. Wiring diagrams: Power, signal, and control wiring, differentiating between manufacturer-installed and field-installed wiring, provided on a schematic diagram.
4. Include representative views of components, including button layouts, engraving, colors, and other physical characteristics pertinent to each device.
5. Load schedules for dimming system: Indicate connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.

D. Source quality-control test reports.
E. Field quality-control test reports.
F. Qualifications of factory certified field service engineer.
G. Operation and maintenance data: For lighting control system and associated components, provide product data, shop drawings, and test reports in operation and maintenance manual. In addition to items specified in Division 01, include the following:
   1. List of replacement parts and assemblies.

1.40 QUALITY ASSURANCE

A. System components shall be UL listed and labeled for their intended application.
B. Provide services from factory certified field service engineer to perform functional testing.
C. Qualifications for factory certified field service engineer:
   1. Minimum experience of 2 years training in the electrical/electronic field.
   2. Certified by the equipment manufacturer on the system installed.
D. Obtain lighting controls system components from a single source with total responsibility for compatibility of lighting control system components and lighting fixtures.
E. Lighting control system installation shall comply with NFPA 70, as well as applicable ANSI and IEC standards, and FCC regulations.
F. Lighting control system shall meet IEC801-2, tested to withstand a 15kV electrostatic discharge without damage or loss of memory.
G. Technical support:
   1. Onsite support: Manufacturer’s authorized service and maintenance representative characteristics shall include the following:
a. Located in the Wilmington, DE metropolitan area.
b. Staff is factory employed and trained.
c. Service available 24 hours a day, seven days a week, 365 days a year.
d. Maintains an adequate stock of manufacturer’s genuine or approved parts to
   service this equipment.
e. Service and maintenance contracts available.

2. Phone support: Toll free technical support shall be available.

1.50 DELIVERY, STORAGE, AND HANDLING

A. Store components indoors in a clean dry space with uniform temperature to prevent
   condensation. Protect switches from exposure to dust, fumes, water, corrosive
   substances, and physical damage.

1.60 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install equipment until spaces are enclosed and weather-tight, wet
   work in spaces is complete and dry, work above equipment 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.
2. The lighting system controls must operate in an ambient temperature range of 0
   degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-
   condensing relative humidity without the requirement of a regularly scheduled
   maintenance program for air filtration components.

1.80 WARRANTY

A. Special warranty: Manufacturer’s standard form in which manufacturer agrees to repair
   or replace components of lighting control system and associated auxiliary components
   that fail in materials or workmanship within specified warranty period.

1. Warranty period: Two years from date of substantial completion.
2. Warranty shall include parts and labor with no deductible.
3. Warranty shall begin at the date the equipment is accepted by the Owner.

B. Warranty service: Qualified personnel shall be available to repair or replace components
   of lighting control system and associated auxiliary components that fail in materials or
   workmanship. Furnish Owner with a telephone number where service representative can
   be reached at all times. Service personnel shall be at the site within 48 hours after
receiving a request for service, and shall restore the lighting control system to proper operating condition within 72 hours.

1.91 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged in protective box or covering for storage and identified with labels describing contents.

1. Occupancy sensors: A minimum of ten (10).
2. Lighting control stations (low-voltage digital wall switches): Five (5) of each type.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide products manufactured by Wattstopper/Legrand, or comparable product including but not limited to one of the following:

2. Eaton/Cooper Controls, Greengate series (basis-of-design).
3. WattStopper/Legrand, Digital Lighting Management (DLM) series.

2.09 SYSTEM REQUIREMENTS

A. General system operation:

1. System shall be capable of receiving input signals from lighting control system sensors, lighting control stations (low-voltage digital wall switches), and fire alarm control modules.
2. Each input and controlled device shall be connected to associated lighting relay room controller via low-voltage signal cabling.

B. System shall comply with UL standards including UL 916 and UL 924.

C. System requirements:

1. Emergency mode: Lighting relay room controllers and associated lighting fixture LED drivers shall comply with UL 924 requirements and operate under the following conditions:

   a. Loss of power: Upon loss of power to a lighting relay room controller, lighting relays shall operate in the closed (‘on’) position and associated LED drivers shall operate in a full light output state. Once normal or backup power
is restored, lighting relays shall remain in the closed (‘on’) position and LED drivers shall remain in a full light output state until a new command is initiated.

b. The default settings for emergency-designated fixtures shall not be capable of being modified.

c. Fire alarm system input: Upon alarm signal from the fire alarm system, lighting relays shall operate in the closed (‘on’) position and associated LED drivers shall operate in a full light output state. Upon alarm silencing, lighting relays shall remain in the closed (‘on’) position and LED drivers shall remain in a full light output state until a new command is initiated.

2. Occupancy detection: The system shall reduce the power consumption in vacant areas by reading the status of low-voltage occupancy sensors.

a. Occupancy sensor wiring: Occupancy sensors shall be wired directly to the associated lighting control system room controller for power and communications. Where the number devices/sensors exceed the amount allowed for a room controller, provide necessary interface devices and power packs to meet controllability intent of the contract documents.

b. Occupancy sensor groupings: The set of light fixtures that are controlled by a given occupancy sensor shall be configurable through associated lighting relay room controller and shall not require any manual wiring to modify.

c. Occupancy sensor modes: Each occupancy sensor shall have the following programmable lighting modes:

1) Occupied mode: The occupied mode represents the lighting mode when occupancy is detected. Light levels will remain at the occupied level until occupancy is no longer detected.

2) Setback or transition mode: Transition or setback modes provide a gradual change in light levels when occupancy is no longer detected.

3) Vacancy mode: The vacancy mode represents the lighting mode when occupancy is no longer being detected and setback and transition levels have expired.

3. Power failure: The lighting control operations shall resume following a power outage to the pre-outage state.

4. Audio/visual system integration: The lighting control system shall be capable of receiving signals from the audio/visual system to activate lighting A/V mode operation.

2.21 LIGHTING RELAY ROOM CONTROLLERS

A. Product:
1. Single-relay room controller: Single lighting relays, and capability for dry contact input from fire alarm system for override. Controllers shall be networkable where necessary for multi-zone areas to be controlled via a single lighting control station.

B. Characteristics:

1. Delivered and installed as a UL listed factory assembly.
2. Input power: Dual-rated 120/277-volt, 60 hertz, phase to neutral.
3. Feed-through type.
4. Relay:
   a. 20-ampere, 120/277-volt rated.
   c. Minimum of 500,000 switching cycles at full load.
6. Capable of switching the following load types:
   a. Light emitting diode (LED) lighting fixtures/luminaires.

C. Functionality: Functions of associated lighting control stations shall be set up at the lighting relay room controllers' electronic controls that include indicated number and arrangement of scene presets, channels, and operational times.

2.22 LIGHTING CONTROL STATIONS (LOW-VOLTAGE DIGITAL WALL SWITCHES)

A. Description: Low-voltage, field-programmable digital wall switch device with button configurations and functions as shown in details or schedules on the Drawings.

B. Functionality: Lighting control station(s) shall provide an immediate local LED illumination response upon button activation to indicate that a system command has been requested. LED will remain lit contingent upon receiving system confirmation of the successful completion of the command.

1. Each button shall be capable of performing an ‘On’ or ‘Off’ operation of the programmed zone.
2. Buttons shall be capable of modifying the state of multiple zones to create a scene.
3. Lighting control station(s) with raise/lower buttons shall have capability of raising or lowering light levels.

C. Lighting control stations shall have control over programmed scenes.

D. Lighting control stations shall be engraved with appropriate zone and scene descriptions, furnished to the manufacturer prior to fabrication. Size and style of engraving type shall be determined by the Architect during submittal stage. Any silk-screened borders, logos, graduations, etc. shall use a graphic process that chemically bonds the graphics to the faceplate, resisting removal by scratching, cleaning, etc. Coordinate exact engraving...
text with Owner prior to order. If Owner does not have a preference, use zone designations indicated on Drawings.

E. Lighting control station(s) functions shall be configurable from associated lighting relay room controller.

F. Configurations: Button-based style with each button fully customizable to perform defined function. Button shall have toggle capability.

1. Provide multi-button configurations as detailed on the Drawings.

G. Device finish: White, with matching device plate.

1. Device plate shall have concealed mounting hardware.

2.23 SENSOR DEVICES

A. Ceiling-mounted occupancy sensors: Wired, dual-technology, combination ultrasonic/passive infrared detector, independently adjustable for installed conditions.

1. Dual-technology detector: Includes both passive infrared and ultrasonic detectors:

   a. Passive infrared: Utilize multiple segmented lens with internal grooves to eliminate dust and residue build-up, with field adjustable ambient light adjustment.

   b. Ultrasonic: Utilize an operating frequency of 32 kHz or 40 kHz, controlled to operate within plus/minus 0.01 percent tolerance. Detector shall automatically adjust detection threshold to compensate for learned environmental behavior.

2. Characteristics:

   a. Indicator: LED positive detection.

   b. Adjustable delayed off-time range: Between 30 seconds and 15 minutes.

   c. Capable of installation in acoustic ceiling tile or gypsum ceiling. Detector shall have 360-degree coverage, minimum 2,000 square feet.

   d. Isolated relay: Provide an internal auxiliary set of contacts with Normally Open, Normally Closed, and Common outputs to allow other systems to monitor occupancy. For use with HVAC control system, or other control options where indicated.

B. Sensor finish color: White.

C. Sensor power packs: Provide when quantity of sensors exceeds the maximum allowable per control circuit. Provide sensor power packs where required for power
connection to sensors. Provide plenum-rated, Class 2 control wiring between sensors and control units.

D. Input/output device: Wired, capable of receiving and transmitting signals to and from lighting control components and third party systems.

2.30 CONDUCTORS AND CABLES

A. Wiring to supply side of remote-control power sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19, Wires and Cables.

B. Low-voltage control cable: Manufacturer’s standard multi-conductor cable with stranded-copper conductors not smaller than No. 22 AWG, plenum rated.

1. Class 2 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.
2. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 14 AWG.

C. Digital UTP cabling: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5E for horizontal copper cable.

2.40 DEVICE PROGRAMMING REQUIREMENTS

A. Programming of lighting controls shall be performed by a factory certified field service engineer. Refer to lighting controls diagrams on the Drawings.

2.90 SOURCE QUALITY CONTROL

A. Perform full-function testing on 100 percent of system components and panel assemblies at the factory.

PART 3 - EXECUTION

3.20 INSTALLATION, GENERAL

A. Install devices in complete compliance with the manufacturer’s recommendations.

B. Ground components according to Section 26 05 26, Grounding and Bonding.

C. Fully document control device calibration settings after system programming with manufacturer’s representative and submit this information as a part of the O&M manual.

D. Devices shall be installed and programmed to meet the control intent.
E. Manufacturer's factory certified field service engineer shall provide start-up service, including physical inspection of lighting control system and connected wiring and final adjustments to meet specified performance requirements. The field service engineer shall submit a report indicating start-up service has been performed and the results of the physical inspection, noting any deficiencies requiring attention. Deficiencies shall be corrected at no additional cost.

3.21 INSTALLING LIGHTING RELAY ROOM CONTROLLERS

A. Room controllers shall be surface mounted in accessible ceiling space above entry door.

B. Provide identification of ceiling grid below room controllers to locate device.

3.22 INSTALLING LIGHTING CONTROL STATIONS (LOW-VOLTAGE DIGITAL WALL SWITCHES)

A. Provide a single cover plate where two or more lighting control stations are grouped together in one box.

B. Verify door swings with door frame installed prior to rough-in for lighting control stations.

3.23 INSTALLING SENSOR DEVICES

A. Install in accordance with manufacturer’s written instructions.

B. Occupancy sensors:

1. Provide low-voltage type detectors.
2. Coverage pattern: Verify coverage pattern of single detector or system of detectors to be capable of complete coverage of the space in which the lighting is intended to be controlled. Provide additional detectors as necessary to satisfy complete coverage.
3. Install at least three feet away from HVAC diffusers, or as indicated in manufacturer’s written instructions.
4. Programming requirements:
   a. Vacancy mode (manual on, automatic off).
   b. Occupancy mode (automatic on, automatic off).

C. Accessory interface devices: Where additional devices are required and need power connection, provide the following:
1. 120-volt circuit: Connect to nearest unswitched receptacle circuit using 2 #12 + #12 ground in 3/4-inch conduit.

D. Provide input/output devices, installed in above accessible ceiling space, as needed for a complete system in compliance with contract document lighting control system performance requirements.

3.59 IDENTIFICATION

A. Materials: Refer to Section 26 05 53, "Identification for Electrical Systems." Identify devices, wiring, and ceiling grid below locations of lighting relay room controllers.

B. Lighting control stations: Provide custom engraving on each button of each lighting control station, defining button’s function. Coordinate with Owner for final approval of engraving prior to ordering.

3.60 FIELD QUALITY CONTROL

A. Manufacturer's field service: Engage a factory certified field service engineer to test and inspect components, assemblies, and equipment installations, including connections.

B. Engage a factory certified field service engineer to make site visits indicated to ensure proper system installation and operation. Visit duration shall be suitable to accomplish required tasks.

C. On-site training: Make two visits for on-site training as described under Article 3.81, Operating Instructions.

D. Lighting control components shall be considered defective if they do not pass tests and inspections.

E. Prepare test reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.80 SYSTEM STARTUP

A. Upon completion of project, engage a manufacturer's certified field service engineer to perform startup service.

1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.

2. Complete installation and startup checks according to manufacturer's written instructions.
3.81 OPERATING INSTRUCTIONS

A. As specified in Section 26 05 00, "Common Work Results for Electrical", provide operating instructions.

B. Engage a factory certified field service engineer to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

C. On-site training:

1. Provide at least two sessions of eight consecutive training hours of instruction time.
2. Train Owner's facility management and maintenance personnel, and selected Owner representatives.
3. Training shall include, but not be limited to, overview, adjustment, operation, use, maintenance, and demonstration of the lighting control system.
4. The first training session shall occur within one month of substantial completion. The second training session shall be scheduled between 6 months and 9 months of substantial completion.
5. Each training session shall include on-site demonstration of lighting control system functionality with the Owner.

END OF SECTION
SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Circuit breaker panelboards, distribution and lighting and appliance branch-circuit types.
B. Fusible branch circuit panelboards.

1.2 RELATED SECTIONS

A. Identification for electrical systems: Section 26 05 53.
B. Overcurrent protective device studies: Section 26 05 73.
C. Fuses: Section 26 28 13.
D. Surge protective devices: Section 26 43 13.

1.3 REFERENCES

A. ANSI/NECA 407: Recommended Practice for Installing and Maintaining Panelboards.
B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
C. NEMA PB 1: Panelboards.
D. NEMA PB 1.1: Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
F. UL 50: Enclosures for Electrical Equipment.
G. UL 67: Panelboards.
H. UL 1449: Surge Protective Devices.

1.4 DEFINITIONS

A. Circuit-breaker panelboards in this section:
1. Distribution panelboard: Capable of accepting up to 600-A branch breakers.
2. Lighting and appliance panelboard: Maximum branch breaker amperage 125 A.

1.5 SUBMITTALS

A. Product data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated.

B. Bill of materials: Provide detailed list of components.

C. Shop drawings: For each type of panelboard, include the following details:
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings in panel schedule format.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Operation and Maintenance Data: For panelboards and components to include in operation and maintenance manuals. In addition to items specified in Division 01 and Section 26 01 01, include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
   3. Copy of each printed panelboard schedule representing final version following installation.

1.6 QUALITY ASSURANCE

A. Do not submit equipment submittals prior to completing Short-Circuit and Coordination Study as indicated in Section 26 05 73.

B. Source limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency accepted by the authority having jurisdiction, and marked for intended location and application; listed as a complete assembly.
   1. UL label and local testing (where required): As specified in Section 26 05 00, Common Work Results for Electrical.
D. Comply with referenced standards and listings previously identified including NEMA PB 1, NFPA 70, and UL 67.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.9 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. Keys: Two spares for each type of panelboard cabinet lock.
2. Furnish spare breakers for panelboards as indicated in schedule on drawings.
3. Furnish spare fuses for fused switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Circuit breaker panelboards: Subject to compliance with requirements, provide circuit breaker panelboards manufactured by Eaton Corporation or comparable product including but not limited to one of the following:

1. Eaton Corporation.
2. General Electric Company.
3. Schneider Electric; Square D products.
4. Siemens Industry, Inc.

B. Fusible branch circuit panelboards: Subject to compliance with requirements, provide fusible branch circuit panelboards manufactured by Eaton Corporation; Bussmann products or comparable product including but not limited to one of the following:
2.2 PANELBOARDS, GENERAL

A. UL listing: UL 67, listed and labeled.

B. Panelboards for service entrance shall be listed and labeled for service entrance.

C. Integrated equipment short-circuit rating: Each panelboard, as a complete unit, shall have a short-circuit rating equal to or greater than the integrated equipment rating shown or scheduled on the drawings.

1. Rating shall be established by testing in accordance with UL 67, with the overcurrent devices mounted in the panelboard. Make short-circuit tests on the overcurrent devices and on the panelboard structure simultaneously, by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. The source shall be capable of supplying specified panelboard short-circuit current or greater.

2. Testing of overcurrent devices only while individually mounted is not acceptable. Testing the bus structure by applying a fixed fault to the bus structure alone is not acceptable.

3. Mark each panelboard with its maximum short-circuit current rating at the supply voltage.

4. Series rating of panelboards with devices outside of the panelboard enclosure are not permitted.

D. Enclosures: Flush- or surface-mounted as indicated, NEMA PB 1, Type 1, UL 50, galvanized steel.

1. Size: Where multiple-width or multiple-section panelboards are indicated or required, each cabinet shall be the same width and height.

2. Provide enclosure type as indicated below or where indicated as listed on drawings:

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Wash-Down Areas: NEMA 250, Type 4X stainless steel.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
E. Directory card: Inside panelboard door, mounted in transparent card holder with information as indicated in Part 3, Identification.


G. Furnish each unit with a master nameplate, listing standard manufacturer information including voltage, ampacity, frequency, and short-circuit ratings; manufacturer's model and project designations.

2.3 CIRCUIT-BREAKER PANELBOARDS

A. Factory-assembled complete with breakers.

B. Cabinets and fronts: Minimum 20 inches wide, wiring gutter space in accordance with UL 67, with minimum four-inch width on every side.
   1. Cabinet front: Door-in-door construction, one or more latches as required for size, with outer door covering the gutter.
   2. Door: Required for sizes up to and including 600 amps.
      a. Lock: Flush, cylinder, tumbler type, with catch and spring-loaded stainless steel door pull. All panelboards shall be keyed alike. Provide two keys per lock. Provide extra keys as required in "Extra Materials" in Part 1 above.
      b. Hinges: Steel, completely concealed.

C. Circuit breakers: UL 489; voltage, continuous-current rating, and interrupting rating as indicated on the drawings or determined by the results of the Short-Circuit Analysis performed under Section 26 05 73, whichever is greater.
   1. Breakers shall be 1-, 2- or 3-pole, with an integral crossbar to ensure simultaneous opening of all poles in multipole circuit breakers.
   2. Operating mechanism: Over center, trip-free, toggle-type with quick-make, quick-break action. Handles shall have on, off, and tripped positions.
   3. Circuit breakers shall be able to be installed in the panelboard without requiring additional mounting hardware or disturbing adjacent units, bars, or branch circuit connections.
   4. Where indicated on the drawings, provide shunt-trip main breakers, standard main breakers, or lugs.
   5. Main and branch circuit breakers shall have device ampacity rating engraved on the front or side of each breaker handle. The breaker rating shall be clearly visible without removing panelboard cover.
   6. Circuit breakers shall be rated for use with 75 deg C wire (conductor temperature rating).
9. Ground-fault circuit interrupter (GFCI) type circuit breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
10. Tandem breakers are not permitted.

D. Bussing assembly and temperature rise: Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the panelboard schedule, established by heat rise tests conducted in accordance with UL 67.
   1. Conductor dimensions shall not be accepted in lieu of actual heat tests.
   2. Current-carrying parts of the bus structure shall be tin-plated aluminum.
   3. Provide a separate ground bus with screw terminals for branch wiring and feed-through lugs.

E. Distribution panelboards: Distribution panelboard shall be capable of accepting up to 800 ampere branch breakers, or as indicated on drawing panel schedules. Current characteristics shall be as scheduled on the drawings.

F. Branch circuit panelboards: Panelboard shall be capable of accepting up to 100-amp branch breakers.
   1. Single-pole, 15 and 20 A circuit breakers intended to switch fluorescent lighting loads on a regular basis shall carry the SWD marking.
   2. Branch breakers serving exit lights, fire alarm, emergency lighting, telephone and security equipment shall be provided with handle-blocking devices which shall prevent accidental operation but not prevent tripping.

2.4 FUSIBLE BRANCH CIRCUIT PANELBOARDS

A. Factory-assembled complete with branch fuse disconnect:
   1. Emergency (life-safety) panelboard(s) shall be fusible branch circuit panelboards.
   2. Main lug only, main fused switch, or main non-fused switch as indicated on the drawings, with main fused switch selectively coordinated with fusible branch switches.
   3. Six spare single-pole 20-ampere fuses, unless otherwise noted.
   4. UL Listed minimum interrupting rating of 200,000 rms symmetrical amperes at 600 volts AC.

B. Cabinets and fronts: Minimum 20 inches wide, wiring gutter space in accordance with UL 67.
1. Cabinet front: Door-in-door construction, one or more latches as required for size, with outer door covering the gutter.

2. Door: Lock, two keys per lock, steel hinges, and circuit directory card on inside of door.

C. Branch fuse disconnects: UL 248, UL 98, and NEMA FU 1; voltage, continuous-current rating, and interrupting rating as indicated on the drawings or determined by the results of the Short-Current Analysis performed under Section 26 05 73, whichever is greater.

1. Incorporating overcurrent protection fuse and disconnecting means into a single integrated finger-safe component (1-pole, 2-pole or 3-pole) mechanically interlocked to prevent removal of the fuse while fuse terminals are energized.

2. Interchangeable from 15 amperes to 100 amperes without requiring additional space.

3. Time-delay UL Listed Class CF power fuses (equivalent to Class J).

4. Visible circuit ON/OFF indication positions and open fuse indication.

5. Permanently installed lockout means in the OFF position.

D. Bussing assembly and temperature rise. Panelboard bus structure and mains shall have current ratings as shown on the drawings:

1. Sufficient cross section to meet UL 67 temperature rise requirements.

2. Current-carrying parts of the bus structure shall be tin-plated aluminum.

3. Provide a separate equipment ground bar and neutral bus bar.

2.5 SURGE PROTECTIVE DEVICE (SPD)

A. As part of the panelboard, provide service entrance SPD specified in Section 26 43 13, Surge Protective Devices where indicated on drawings. Note the requirement of that section for a single manufacturer to provide all SPD of all types in the project.

2.6 SOURCE QUALITY CONTROL

A. With branch circuit breakers installed, short-circuit test panelboards as complete units, in accordance with requirements of UL 67.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach panelboards to the wall where indicated on the drawings. Install in accordance with NEMA PB 1.1 and manufacturer's written installation instructions.

1. Mounting height:
a. 72 inches (1829 mm) to top of panelboard.
   b. Panelboards taller than 72 inches (1829 mm): Bottom edge no more than 4-inches (102 mm) above floor.
   c. Top breaker maximum height: No more than 6-feet, 7-inches (2.0 m) above the floor or working platform.

B. Comply with applicable portions of NECA 407.

C. Frame and mount printed circuit directory indicating type and location of equipment on each circuit.

D. Wiring in gutters: Arrange conductors into groups, and bundle and wrap with wire ties.

E. Install filler plates in unused spaces.

3.2 CONNECTIONS

A. Connect panelboards and components to wiring and to ground as indicated.

B. Shared neutral conductors shall not be permitted, except where indicated.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Materials: Refer to Division 26 Section "Identification for Electrical Systems." Identify units, auxiliary devices, controls, and wiring. Identify equipment ratings.

B. Nameplates: Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements. Provide identification nameplate for each panelboard and associated components located on front of assembly.

C. Identify field-installed wiring and components. Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements.

D. Provide printed directory for each panelboard. Handwritten directories are not acceptable. Copying of panel schedules and descriptions on drawings is not acceptable. Circuit directory shall reflect final circuit installation. Include the following information:

1. Panelboard designation and room location.
2. Circuit breakers, size and number of poles.
3. Circuit or feeder description including destination room name(s) and number(s).
5. Panelboard ratings: Main bus ampacity, main circuit breaker or main lug ampacity, AIC rating.
6. Incoming primary feeder size and source panelboard circuit designation.

E. Room names and numbers on the panelboard circuit directories shall match names and numbers used by the Owner. Note that room names and numbers on the drawings may not match the Owner's final room name and numbering scheme.

3.4 FIELD QUALITY CONTROL

A. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuit.

B. Make continuity tests of each circuit.

C. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

A. Clean interior and exterior of panelboards.

B. Refinish painted surfaces damaged during construction to match the rest of the panelboard.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 26 27 16 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Indoor enclosures.
B. Weatherproof enclosures.

1.2 RELATED SECTIONS

A. Equipment foundations: Section 26 05 28.

1.3 SUBMITTALS

A. Product data: Each type of enclosure required for the project.

PART 2 - PRODUCTS

2.1 INDOOR ENCLOSURES

A. Type 1 in accordance with NEMA 250 and conforming to UL 57, of size required by NEC to fit equipment or as shown on the drawings.

B. Construction: Code grade galvanized steel.

2.2 WEATHERPROOF ENCLOSURES

A. Type 3R in accordance with NEMA 250 and conforming to UL 57, of size required by NEC to fit equipment or as shown on the drawings.

B. Construction: Fabricated of 14-gauge galvanized steel, with drip shield top and smooth, seam-free sides and back.

C. Doors: Double doors fabricated from 12-gauge galvanized steel, overlap type without center post.

1. Door gaskets: Neoprene, attached with oil-resistant adhesive and held in place with steel retaining strips.
2. Full-length piano hinges.
3. Locks: Keyed, with all keys alike. Provide two keys with each enclosure.

D. Provide steel channels in rear of cabinet for mounting metering equipment.
2.3 FINISHES

A. Satin gray enamel, inside and out.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach enclosure to wall on plywood backboard, set on housekeeping pad, or hang on frame, as indicated.

3.2 LOCATIONS

A. Provide indoor type inside building and weatherproof type in exterior locations.

END OF SECTION
SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Switches and receptacles.
B. Relays.
C. Terminal blocks.
D. Contactors.
E. Cord reels

1.2 RELATED SECTIONS

A. Nameplates: Section 26 05 53.

1.3 SUBMITTALS

A. Product data: Each type of device used in the project.

PART 2 - PRODUCTS

2.1 SWITCHES AND RECEPTACLES

A. Acceptable manufacturers:

1. Pass & Seymour, Inc.
2. Leviton Manufacturing Co.
3. Hubbell/Bryant Electric
4. Cooper Industries/Cooper Wiring Devices.

B. Provide devices conforming to UL 20 for switches and UL 498 for receptacles, equal to the following Pass & Seymour catalog numbers or NEMA WD 1 and WD 6 configuration numbers:

2. Switches with pilot light (illuminated clear toggle when in OFF position): PS20AC1-CSL.
a. Weatherproof cover: WIUC10FRED.

5. GFCI receptacles: 2097, NEMA 5-20R.
   a. Weatherproof cover: WIUC10FRED.
   b. Exterior and wet locations: 2097TRWR, 20 amps, weather-resistant, tamper-resistant.
   c. Interior cover: WP26 vertical, WPH26 horizontal.


C. Device color:
   1. Switches and general-purpose receptacles: Light almond.

D. Device plates: Equal to P&S: Type 302 stainless steel, SS Series.
   1. Device plates for receptacles controlled by an automatic control device shall be custom engraved for metal, or pad printed for plastic, and shall identify the device with the words “Switched Receptacle”.

2.2 RELAYS

A. Relays: Equal to Square D Company, Class 8501 Type C in NEMA 250 type 1 enclosure.

B. Contacts: Double-break, fine silver, convertible from normally open to normally closed contacts. Provide contact status indication.

C. Coils: Molded construction, terminals provided with pressure wire connectors.

D. Coil voltage and number of contacts shall be as indicated on the drawings.

2.3 TERMINAL BLOCKS

A. Terminal blocks: Equal to Square D, screw-terminal type, size as required by NFPA 70, NEMA 250 Type 1 enclosure with hinged cover.

2.4 CONTACTORS

A. Contactors: Equal to Square D Class 8903 contactor type LXG, UL 508 listed, in NEMA 250 Type 1 enclosure, mechanically held, double-break, continuous-duty contacts rated 30 amps at 600 Vac, 60 Hz; number of poles indicated on drawings; HOA selector switch on cover.
2.5 CORD REELS

A. Standard duty retractable cord reel with power accessories. Provide enclosed drum, rigid mount unit with minimum 35 feet cord (12/3 SOW) and ball stop. Provide 1 NEMA 5-20 duplex receptacles in cast outlet box. Cord reel shall be equal to Woodhead Model 997.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices in complete compliance with the manufacturer’s recommendations.

B. Receptacles orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

C. 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.

D. Arrangement of devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent devices under single multi-gang wall plates.

3.2 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face and on back of plate, and durable wire markers or tags inside outlet boxes.

C. Attach nameplates securely to receptacle cover plates. Provide nameplates for all devices except 120-volt receptacles, identifying equipment and use.

END OF SECTION
SECTION 26 28 00 - ENCLOSED CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed switches (disconnects/safety switches).

1.2 RELATED SECTIONS

A. Motors: Sections 22 05 13 and 23 05 13.
B. Fuses: Section 26 28 13.
C. Overcurrent protective device study: Section 26 05 73.

1.3 REFERENCES

A. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
B. UL 98: Enclosed and Dead-Front Switches.

1.4 SUBMITTALS

A. Product data: Each type of enclosed switch and enclosed circuit breaker.

1.5 QUALITY ASSURANCE

A. Comply with the following standards:

1. NEMA KS 1 for enclosed switches.
2. UL 98.
3. UL 198E.

B. UL label and local testing (if required): As specified in Section 26 05 00, Common Work Results for Electrical.

PART 2 - PRODUCTS

2.1 ENCLOSED SWITCHES (DISCONNECTS/SAFETY SWITCHES)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Corporation.
2. General Electric Company.
3. Schneider Electric; Square D products.
4. Siemens Industry, Inc.

B. Properly size switches for number of poles and provide fused or non-fused as required for project conditions and to meet NFPA 70 requirements.

1. Neutral kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

C. Fuse contacts and quick-make/quick-break jaws shall ensure positive contacts with reinforcing spring clips or other approved means.

D. Switches shall be front-operated.

E. Current-carrying parts: Plated copper.

F. Hinges: Noncurrent-carrying.

G. Switches shall be lockable in either open or closed position.

H. Type:

1. Nonfused switches: Heavy-duty type on all voltages.
2. Fused switches: Heavy-duty type on all voltages.

I. Enclosures: Indoors NEMA 250 Type 1; outdoors Type 3R with raintight hubs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches where indicated and as required for motor outlets, transformers, and other equipment.

B. Securely attach and properly connect enclosed switches.

C. Provide an enclosed switch for each motor, as required by NFPA 70, except where it is provided in a panelboard within sight and easy reach of the motor, and provide wiring and connections from source. Enclosed switches shall be fused where protection is required or indicated on drawings and unfused elsewhere.

D. Enclosed switches:
1. Provide neutral kit where required for four-wire application.

END OF SECTION
SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses.
B. Spare fuse cabinet.

1.2 RELATED SECTIONS

A. Motors: Sections 22 05 13 and 23 05 13.
B. Enclosed switches: Section 26 28 00.

1.3 REFERENCES

A. UL 198E: Class R fuses.
B. UL 198C: High-Interrupting-Capacity Fuses, Current Limiting Types.

1.4 SUBMITTALS

A. Product data: Each type of fuse.
B. Published data on fuses shall include time/current curves, peak-let-through curves and I^2t melting and clearing curves.

1.5 QUALITY ASSURANCE

A. Comply with UL 198C, Class L fuses, also Classes G and J.
B. UL label and local testing (if required): As specified in Section 26 05 00, Common Work Results for Electrical.

1.6 EXTRA MATERIALS

A. Provide ten percent spare fuses, minimum three spare fuses, for each type fuse in the work.

PART 2 - PRODUCTS

2.1 FUSES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Bussmann
2. Littelfuse, Inc.
3. Mersen

B. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

C. Fuses 0-600 amps for 600 V or 250 V, UL labeled Class RK1 with time delay, with a minimum short-circuit interrupting capacity of 200,000 rms symmetrical amperes, and shall carry 500 percent of rating for a minimum of 10 seconds.

1. Fuses for disconnecting switches for packaged HVAC equipment: Size and type recommended by the equipment manufacturer and as required for equipment to meet UL rating.

2.2 SPARE FUSE CABINET


PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses where indicated and as required for motor outlets or other equipment.

B. Securely attach spare fuse cabinet to wall, where indicated on the drawings or in a convenient location selected by Owner’s representative.

END OF SECTION
SECTION 26 29 14 - ENCLOSED MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Alternating-current motor starters (enclosed controllers) rated 600 V and less that are supplied as enclosed units.

1.2 RELATED SECTIONS

A. Motors and variable-frequency drives: Sections 22 05 13, 23 05 13, and 26 29 23.

1.3 SUBMITTALS

A. Product data:
   1. Each type of motor starter included in the project, including dimensions, ratings, and data on features and components.

B. Shop drawings: Composite wiring diagram showing the interlocking and control wiring.

C. Operation and maintenance data: For operating and maintenance manuals, as specified in Section 26 01 01.

1.4 QUALITY ASSURANCE

A. Source limitations: Obtain motor starters of a single type through one source from a single manufacturer.

B. Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate layout and installation of motor starters with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for work space and for access.
B. Coordinate features, accessories, and functions of each motor starter with ratings and characteristics of supply circuit, motor, control sequence, and duty cycle of motor and load.

1. Refer to wiring diagrams required in the sections specifying the equipment.

PART 2 - PRODUCTS

2.1 MOTOR STARTERS, GENERAL

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Schneider Electric; Square D products, or comparable products by one of the following:

1. Eaton Corporation
2. General Electric Company
3. Schneider Electric; Square D products
4. Siemens Industry, Inc.

2.2 MANUAL MOTOR STARTERS

A. Enclosures: NEMA 250 Type 1 for interior use and NEMA 250 Type 3R for exterior or damp or wet locations.

1. Mounting: Flush-mounted in finished areas and where possible; surface-mounted elsewhere, with cover plates to suit the mounting.
2. Indicating lights mounted in enclosure.
3. Engraved plastic identification plates.

B. Manual motor-starting switch: Equal to Square D Class 2510, single- or two-pole as required, with built-in thermal overload protection.

C. Switch: Toggle, quick-make and quick-break, with self-indicating, trip-free handle, and means for locking in Off position.

D. Overload protection unit: Melting-alloy type, interchangeable; starter shall be inoperative if unit is removed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For equipment not at walls, mount on lightweight structural-steel channels bolted to floor or to structure above ceiling.
B. Provide wiring as indicated on the drawings.

C. Install starters, auxiliary contacts, and automatic control devices furnished with equipment, except those that are already mounted on the equipment, fully wired and connected. See coordination requirements specified in Part 1 above.

D. Check the size of the overload protection, and change or adjust it as required, after the HVAC systems have been adjusted and balanced as specified in Section 23 05 93, Testing, Adjusting, and Balancing.

END OF SECTION
SECTION 26 29 23 - VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Variable frequency drives, rated less than 600V, for speed control of three-phase, induction motors.

1.2 RELATED SECTIONS

A. Motors: Section 23 05 13.
B. Pumps: Section 23 21 23.
C. Fans: Section 23 34 00.
D. Controls: Sections 23 09 01 through 23 09 23.

1.3 REFERENCES

B. NEMA: Application Guide for AC Adjustable Speed Drive Systems
C. NEMA ICS 61800-2: Adjustable Speed Electrical Power Drive Systems
D. NEMA ICS 7.0: Industrial Controls & Systems for Adjustable Speed Drives
E. NEMA ICS 7.1: Standard Standards for Construction and Guide Selection, Installation, and Operation of Adjustable Speed Drive Systems
F. NEMA MG 1: Motors and Generators
G. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
H. NFPA 70: National Electrical Code
I. UL 508: Standard for Industrial Control Equipment
J. UL 508C: Standard for Safety for Power Conversion Equipment
1.4 SUBMITTALS

A. Product data: For each type and rating of equipment, include electrical ratings, operating characteristics, manufacturers’ technical data on features and functions, enclosures, and furnished accessories. Include product data for each of the following:

1. Variable frequency drive (VFD).
   a. List rated capacities and relationship to motor values including voltage, horsepower, rated current, and short-circuit ratings.

B. Bill of materials: Provide detailed list of components.

C. Shop drawings: For each type of unit, indicate the following:

1. Dimensioned plans, elevations, and sections; weights; loads; required clearances; mounting arrangements; components; and location of each field connection.
2. List of installed device and related equipment ratings and features including:
   a. Unit type and standard details
   b. Enclosure type
   c. Nameplate and identification labels
   d. Factory settings of installed devices

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and maintenance data: For each type of variable frequency drive and associated components, include in operation and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Detailed operating and programming instructions.
2. Troubleshooting procedures.
3. Detailed spare parts list.
4. Warranty, executed and signed at the time of putting the unit in service.

G. Laminated list of fault codes associated with variable frequency drive.

1.5 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; listed as a complete assembly.

1. UL label and local testing (where required): As specified in Section 26 05 00, Common Work Results for Electrical.

B. Variable frequency drives shall be fully assembled, inspected, and tested at the factory prior to shipment.

C. Installer qualifications:

1. Staff is authorized and factory-trained by manufacturer, includes training in electrical safety as required by NFPA 70E and qualified as defined in NEMA PB 2.
2. Maintains a service center location with staff factory-trained by manufacturer within 50 miles of the project site.
3. Service available 24 hours a day, seven days a week, 365 days a year.
4. Maintains an adequate stock of manufacturer’s genuine or approved parts to service this equipment.
5. Service and maintenance contracts available.

D. Testing agency qualifications: Member company of NETA or a nationally recognized testing laboratory (NRTL).

1. Testing agency’s field supervisor: Currently certified by NETA to supervise on-site testing.

E. Comply with referenced standards and listings previously identified including NEMA MG 1, UL 508C, and NFPA 70.

F. Verify motor, drive, and load compatibility. Motors shall be inverter duty rated, per NEMA MG1.

1.6 COORDINATION

A. Ratings and functions of each variable frequency drive unit shall be coordinated with associated motor and connected load including the following:

1. Load requirements such as torque, speed, and horsepower.
2. Motor and power supply characteristics.
3. Control and operational sequences.
4. Ambient, environmental, and physical conditions of installation location.
B. Coordinate layout and installation of drive and associated components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access.

C. Coordinate method and location for mounting equipment including size and location of housekeeping pads and structural channel supports.

D. Coordinate location of underslab and overhead conduit.

E. Coordinate with ATC for proper control and communications functions.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 PROJECT CONDITIONS

A. Special environmental conditions: Where indicated on the drawings, provide equipment with enclosure ratings suitable for the installed space. Enclosure ratings shall comply with NEMA 250 and UL standards.

1.9 WARRANTY

A. Special warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of drive unit and associated auxiliary components that fail in materials or workmanship within specified warranty period:

1. Warranty period: Five years from date of substantial completion.
2. Warranty shall include all parts and labor.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Control power fuses: Six of each type and rating used.
2. Indicating lights: Six of each type installed.
3. Touchup paint: Three containers of paint matching enclosure finish, each 0.5 pint (250mL).

PART 2 – PRODUCTS
2.1 MANUFACTURERS

A. Variable frequency drives: Basis-of-design product: Subject to compliance with requirements, provide products manufactured by ABB, Inc., or comparable product by one of the following:

1. ABB, Inc.
2. Eaton Corporation
3. Emerson Industrial Automation
4. General Electric Company
5. Mitsubishi Electric Automation, Inc.
6. Schneider Electric; Square D products
7. Siemens Industry, Inc.
8. Toshiba International Corporation; Industrial Division
9. Trane/Danfoss
10. Yaskawa Electric America, Inc

B. Harmonic mitigating devices: Subject to compliance with requirements, provide products offered by the variable frequency drive manufacturer or one of the following independent manufacturers:

1. Trans-Coil, Inc. (TCI)
2. Mirus International Inc.
3. MTE, an SL Power Electronics Company

2.2 VARIABLE FREQUENCY DRIVES

A. Description: Enclosed variable frequency, alternating-current (AC) motor controller assembly suitable for operation of inverter-duty, Design A and Design B, induction motors as defined by NEMA MG1. The drive shall be designed for variable torque applications.

1. Unit shall be a packaged assembly including power conversion components, disconnecting means, overcurrent and overload protection, and control components.

B. Equipment ratings and design:

1. Ratings: VFD shall be sized to match the motor load type served. The motor current, voltage, and/or horsepower ratings are scheduled on the drawings. The following drive ratings shall also apply:

   a. Input power characteristics: Unit shall be capable of continuous operation under the following conditions.
(1) Voltage variation: Plus 10 percent or minus 15 percent, nominal 208 VAC or 480 VAC.
(2) Frequency variation: Plus or minus 5 percent, 60 Hz.
(3) Power factor (input-primary side): 0.95 minimum.

b. Output power characteristics: 0 to Rated Input Voltage, 3-phase, 0 to 120 Hz.

(1) Current: Drive shall be capable of continuous operation at rated full load motor current.
(2) Power factor (output-secondary side): 0.90 minimum.

c. Minimum efficiency: 95 percent at half speed; 97 percent at rated full speed.
d. Overload capability: 110 percent of the normal duty current rating for 60 seconds, and 130 percent for 2 seconds.
e. Short-circuit current (withstand) rating: Minimum 65 kA, without additional input fuses, or available fault current value determined by short circuit analysis, whichever is greater.
f. Audible noise: Motor and VFD combination noise level shall not be increased more than 2 dBA at 3 feet (1m), compared to motor operation from across-the-line motor control.
g. Output carrier frequency: Unit shall have adjustable frequency switching settings up to 4 kHz without derating the drive output characteristics. Drive selection size may be increased to comply.

2. Design: Unit shall consist of the following components and characteristics:

a. Power conversion components: Microprocessor based control.

(1) Rectifier: Solid state, full-wave, diode-bridge rectifier used to convert AC input power to DC power, with metal-oxide-varistor (MOV) surge protection.

(a) Provide 6-pulse drives with harmonic filters.

(2) DC bus: DC-bus reactor and capacitor components to minimize reflected harmonics and manage DC power to inverter. Bus shall interface with VFD programmable logic controller, for continuous monitoring and protection of system components, and include short circuit protection and filtering.

(3) Inverter: Insulated-gate-bipolar-transistor (IGBT) type employing pulse-width-modulated (PWM) technology power supplies for sine-code, AC output waveform.

b. Standard power conditioning components: Provide the following power conditioning and filter devices.

(1) Integral, DC link reactor.
C. Construction:

1. Enclosure: UL (NEMA 250) Type 1 according to UL 508; or as scheduled on the drawings.
   
   a. For units located outdoors and subject to direct sun exposure, provide sun shields over front, side and top of enclosures.

2. Completely assembled and tested by the manufacturer. Listed and labeled as a complete assembly under UL 508C.

3. Furnish each unit with a master nameplate, listing standard manufacturer information including voltage, ampacity, frequency, and short-circuit ratings; manufacturer’s model and project designations.

D. Drive features:

1. System interface:
   
   a. Digital display and keypad operator station sealed and located on front of assembly.

   (1) Operator interface shall provide complete programming, program copying, operating, monitoring, and diagnostic capabilities.

   (2) Operator interface shall include menus and selections to display system characteristics such as metering, program parameters, settings, and messages. Standard displays shall include:

   (a) Output frequency (hertz).
   (b) Set-point frequency (hertz).
   (c) Motor current (amperes).
   (d) DC-link voltage (volts-dc).
   (e) Motor torque (percent).
   (f) Motor speed (rpm).
   (g) Motor output voltage (volts).
   (h) Historical Information: Displays indicating current time and date, total run time, total power versus time log, and fault log.

   (3) Keypad shall include Hand-Off-Auto selections in addition to programming and control keys.

   (4) Security access: Capable of preventing access by unauthorized personnel and protecting data and system parameters.

   b. System input characteristics capable of accepting remote signals from the Building Automation System (BAS) shall include the following:
VARIABLE FREQUENCY DRIVES

(1) Minimum of six programmable, multifunction digital inputs.
(2) Minimum of two programmable analog inputs accepting current or voltage signals for speed reference.
(3) Minimum of one external fault input, programmable for normally open or normally closed contact, used for connection of freeze, fire, smoke contacts, or high pressure limits.

c. System output characteristics including the following:

(1) Minimum of three programmable, multifunction, digital, Form-C type, relay outputs.
(2) Minimum of two programmable analog outputs.
(3) Programmable loss-of-load, Form-C type, relay output dedicated to drive protection under motor failure condition.

2. Building automation system (BAS) interface: Factory-installed or optional card hardware and software package to enable the BAS to monitor, control, and display VFD status, alarms, and energy usage.

b. Integral or removable communications card embedded with standard BAS protocols including Johnson Controls, Modbus, Siemens Building Technologies, and BACnet. Additional protocols such as LonWorks, DeviceNet, Ethernet TCP/IP, and Profibus shall be available with the addition of an optional card.

3. Provide separate terminal strip and four auxiliary contacts for connection to remote device providing remote start/stop signals. All interlocks and start/stop contacts shall remain functional whether the drive is in Hand or Auto.

4. Local Communication Port: RS-232 or USB 2.0 for connection of portable computer or peripheral device.

5. Cooling fans: VFD shall incorporate cooling fan system to dissipate heat from assembly to maintain drive temperature control.

6. Control power for drive controls as well as digital inputs and outputs shall be derived from internal power supply or control system power source.

E. Drive functions: The VFD shall include the following functions, either pre-programmed or field-programmed according to project requirements.

1. Minimum of three programmable preset speeds.
2. The ability to automatically reset and restart after an overcurrent, overvoltage, undervoltage, or over-temperature condition; overload fault; loss of phase, or loss of input signal.
3. Capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to programmed set point without drive tripping or component damage.

4. Capable of adjusting acceleration and deceleration ramp control time from 1 to 360 seconds.

5. Equipped with an automatic extended power loss ride-through circuit which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be 12 cycles (200 milliseconds), based on full load and no inertia. Control logic shall incorporate programmable ride-through with minimum one-second (60 cycles).

6. Stop modes shall be field-selectable allowing the VFD to ramp or coast to a stop.

F. Drive and motor protection: Include the following electrical protection and safety features, factory mounted and wired within the VFD enclosure.

1. Input disconnecting means and overcurrent protective device: Integral, NEMA AB1, thermal magnetic, molded-case circuit breaker, with door interlocked, padlockable handle mechanism connected to input line side of drive.
   a. Circuit breaker shall be selected to provide trip-free operation. Breaker trip size and thermal curve shall be selected to allow VFD to operate the motor under continuous running and starting conditions as recommended by the motor manufacturer.

2. Transient voltage surge suppression (TVSS): Integral, system to provide three-phase protection against damage from supply voltage surges.

3. Motor and VFD overload and overtemperature protection: NEMA ICS 2, solid-state, overload relay protection monitoring both motor and VFD characteristics. Relay shall be interconnected with motor thermal couple.

4. Protective relays or functions for the following conditions:
   a. Overvoltage
   b. Undervoltage
   c. Phase loss
   d. Phase reversal
   e. Ground fault

5. Programmable, critical frequency lock-out: Multi-range selection, preventing VFD from operating load continuously at an unstable speed.

6. Control fuses utilized within the drive enclosure shall be 100,000 A current limiting type. Input AC power fusing is not acceptable.

G. Comply with requirements of NEMA ICS 7, NEMA ICS 61800-2, and UL 580C.

2.3 DRIVE CONTROL AND OPERATION
A. VFD shall operate according to the following scenarios:

   1. “Hand”: VFD shall start and speed controlled manually through user interface.
   2. “Off”: VFD shall stop or disregard start signal.
   3. “Auto”: VFD shall start via external contact closure or control signal reference.

B. VFD shall run at programmable preset speed if input reference signal is lost.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect variable frequency drive units and associated controls according to requirements in NEMA ICS 61800-2 and UL 508C.

   1. Perform tests at rated full load to ensure proper operation.
   2. Provide three certified copies of factory test reports.

B. Each drive shall undergo a burn-in test at 100 percent inductive or motor load prior to final testing.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine project submittals for compliance with electrical distribution system requirements outlined on the drawings and in electrical specification sections.

3.2 INSTALLATION

A. Install drive units in locations shown on drawings. Equipment shall not be located further from the equipment it serves than the maximum distance recommended by the drive manufacturer.

B. Install wiring between drive and motor in ferrous metallic conduit, with separate conduits for power input, power output, and control wiring.

   1. Maintain minimum separation between conduits of 3 inches.

C. Service engineers trained and authorized by the variable-frequency drive manufacturer at the service center shall provide start-up service, including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

3.3 IDENTIFICATION
A. Materials: Refer to Section 26 05 53 for requirements on identification of electrical systems. Identify units, devices, fuse blocks, relays, controls, and wiring. Identify equipment ratings.

B. Nameplates: Refer to Section 26 05 53 for requirements on identification of electrical systems. Provide nameplate for each drive unit and associated components located on front of assembly.

C. Control components mounted within the assembly shall be identified corresponding to designations on manufacturer’s drawings using tags and other identification materials.

D. Operating instructions: Provide fabricated frame on side of each unit to house operating instruction manuals.

3.4 FIELD QUALITY CONTROL

A. Test variable frequency drives by operating them in all modes with associated components and motors. Perform tests recommended by manufacturer under supervision of manufacturer’s factory-authorized representative. Tests shall include simulation of various building conditions through the BAS control system.

B. Coordinate tests with system balancing of fan and pump equipment.

C. Perform mechanical and visual inspection of equipment installation including verification of wiring and components, connections, enclosures, and auxiliary devices and components.

D. Perform testing in compliance with NETA ATS. Perform manufacturer standard tests including the following:

   1. Test insulation resistance and circuit continuity for power and control wiring.
   2. Verify voltage values follow nameplate ratings at drive input and output terminals.

E. Correct deficiencies and retest equipment until equipment is operational. Report results and identify corrections in writing. Where necessary, replace damaged and malfunctioning equipment.

F. Record field adjustable settings.

3.5 ADJUSTING

A. Program variable frequency drives for required operations as outlined by the mechanical control sequences.
B. Set field-adjustable elements such as switches, relays, timers, and trip devices as required for proper system operation and coordination with related power and control systems.

3.6 CLEANING

A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish. Clean components internally using methods and materials recommended by the manufacturer.

3.7 SYSTEM STARTUP

A. Perform startup service.

3.8 OPERATING INSTRUCTIONS

A. As specified in Sections 26 05 00, provide operating instructions.

B. Provide at least two sessions of four consecutive hours of additional instruction time for each system specified in this section.

END OF SECTION
SECTION 26 32 13 - GENERATORS, WEATHER-PROTECTED

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Packaged engine generator set for standby, emergency power application including the following:
   1. Liquefied-petroleum (LP) gas engine with electronic generator set controls, governor, and voltage regulator.
   2. Located in outdoor, weather-protected, sound-attenuated enclosure.
   3. Complete with remote annunciator and generator accessories.

1.2 RELATED SECTIONS

B. Grounding and bonding: Section 26 05 26.
C. Equipment foundations: Section 26 05 28.
D. Transfer switches: Section 26 36 00.

1.3 REFERENCES

B. CFR Title 40, Protection of Environment.
C. IEEE 115: Test Procedures for Synchronous Machines.
D. IEEE 446: Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
E. NECA/EGSA 404: Standard for Installing Generator Sets.
F. NEMA MG 1: Motors and Generators.
I. NFPA 37: Installation and Use of Stationary Combustion Engines and Gas Turbines.


L. UL 1236: Battery Chargers for Charging Engine Starter Batteries.

M. UL 2200: Stationary Engine Generator Assemblies.

1.4 DEFINITIONS


B. EPA: Environmental Protection Agency.

C. NIST: National Institute of Standards and Technology


1.5 SUBMITTALS

A. Product data: For each type of packaged generator set indicated. Include rated capacities, operating characteristics, manufacturers’ technical data on features and functions, finishes, and furnished accessories. Include product data for each of the following:

   1. Engine generator set.

      a. Thermal damage curve for generator.
      b. Time-current characteristic curves for generator protective device.
      c. Documentation proving that generator(s) provided have sufficient starting kVA to start the loads under any load sequence.

   2. Generator accessories including batteries and battery charger, silencer, and jacket heater.

   3. Remote alarm annunciator panel.

   4. Enclosure components and accessories.

B. Bill of materials: Provide detailed list of components.

C. Shop drawings: For each type of generator set and related equipment, detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Design calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for designing vibration isolation bases.
3. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
5. Piping schematics for fuel system, lubricating oil, jacket coolant, and cooling water.

D. Source quality-control test reports.
   2. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   4. Report of exhaust emissions showing compliance with applicable regulations.
      a. Factory certification of compliance with EPA emissions regulations.

E. Field quality-control test reports.

F. Operation and maintenance data: For packaged engine generator sets, accessories, and remote annunciator panel to include in operation and maintenance manuals. In addition to items specified in Division 01, include the following:
   1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
   2. Detailed operating instructions for event conditions.
   3. Fuel adjustment procedures and maximum tolerances of wear on bearings and other rubbing surfaces that will require corrective measures.

G. Warranty: Certificate of special warranty.

H. Air quality permits: Submit air quality construction and operational permits for Owner record.

1.6 QUALITY ASSURANCE

A. Generator accessories, appurtenances, and installation of the same, shall comply with referenced codes and standards listed in Part 1 and applicable federal, state, and local codes and regulations.

C. Permits: Serve as the Owner’s representative during the application process. Collect generator information, prepare and submit required applications for air quality construction and operational permits required by the State of Delaware Department of the Environment in compliance of state environmental regulations. Include payment for applicable permit costs. Approved permits and registration shall be issued to the Owner.

D. Equipment shall bear UL label, and shall be locally tested by an electrical testing specialist, acceptable to local authority having jurisdiction where required.

E. Source limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

F. Installer qualifications: Manufacturer’s authorized representative who is trained and approved for installation of units required for this project.
   1. Installer has training in electrical safety as required by NFPA 70E and is qualified as defined in NEMA PB 2.

G. Testing agency qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
   1. Testing agency’s field supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

H. Service and maintenance agency qualifications: Manufacturer’s authorized service and maintenance representative characteristics shall include the following:
   1. Located in the Wilmington, DE metropolitan area.
   2. Staff is factory employed and trained.
   3. Service available 24 hours a day, seven days a week, 365 days a year.
   4. Maintains an adequate stock of manufacturer’s genuine or approved parts to service this equipment.
   5. Service and maintenance contracts available.

1.7 COORDINATION

A. Obtain interconnection diagrams, interface hardware, accessory components, and installation manual for generator, and other components of the system. Coordinate installation to provide a complete, integrated, operating generator system.
1. Coordinate installation and interface connections with other emergency power supply system equipment.

B. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate terminations of generator exhaust and fuel piping outside of generator enclosure.

1.8 PROJECT CONDITIONS

A. Environmental conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient temperature: Minus 15 to plus 40 deg C.
2. Relative humidity: 0 to 95 percent.
3. Altitude: Sea level to minimum 1000 feet (300 m).

1.9 WARRANTY

A. Special warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period:

1. Warranty period: Five years from date of substantial completion.
2. Warranty shall include all parts and labor with no deductible.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every ten of each type and rating, but no less than one of each.
2. Indicator lamps: One for every five of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

B. Provide fuel required for testing, re-testing, and demonstrations.

1.11 MAINTENANCE SERVICE

A. Initial maintenance service: Beginning at Substantial Completion, provide 12 months, full maintenance by skilled employees of manufacturer’s designated service organization.
Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide products manufactured by Kohler Power Systems, or comparable product by one of the following:

1. Caterpillar; Power Generation
2. Cummins Power Generation/Onan
3. MTU
4. Generac
5. Kohler Power Systems Co.; Generator Division

2.2 GENERATOR SET

A. Generator set characteristics: The generator set system shall comprise of a package of equipment including:

1. A liquefied-petroleum (LP) gas engine and alternator assembly to provide emergency electric power.
2. Generator-mounted start-stop control system.
3. Mounted accessories as specified.

B. Generator set ratings:

1. Duty rating shall be based on emergency/standby service.
2. Operate at 1800 rpm and 208/120 volts AC, 3-phase, 4-wire, 60 hertz.
3. The generator set shall be rated at values indicated on the drawings at 0.8 pf based on the project conditions listed in Part 1.

C. Performance characteristics:

1. The engine-generator set shall be able to handle the starting step load effects of the connected equipment, where each transfer switch represents a step. Details on load size and quantity are shown on drawings.
2. Generator set characteristics shall not exceed the following:

   a. Starting voltage dip: 30 percent.
   b. Peak voltage dip: 15 percent.
c. Frequency dip: 10 percent. 
d. Voltage regulation (no load to full load): Plus or minus 1 percent of rated output voltage. 
e. Voltage regulation (random): Plus or minus 0.5 percent of rated output voltage. 
f. Transient Voltage: 20 percent variation for 50 percent step load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds. 
g. Frequency regulation (steady-state): Isochronous. 
h. Frequency regulation (random): Plus or minus 0.25 percent of rated frequency from no load to full load. 
i. Transient frequency: Less than 5 percent variation for 50 percent step load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds. 

3. AC output waveform: Distortion at no load measured line-to-line or line-to-neutral. 
   a. Total harmonic distortion (THD): Less than 5 percent 
   b. Single harmonic: Less than 3 percent. 
   c. Telephone influence factor (TIF): Less than 50, as determined by NEMA MG 1. 
   d. Telephone harmonic factor (THF): Less than 3, as determined by IEC 60034. 

4. Steady-state frequency stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed. 

5. Sustained short-circuit current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components. 

6. Start time: Comply with NFPA 110, Type 10, Level 1, system requirements. 
7. Excitation system: Performance shall be unaffected by voltage distortion caused by nonlinear load. 

D. Engine: 

1. Liquefied-petroleum (LP) gas engine: Four-cycle, with liquefied-petroleum (LP) gas backup (vapor-withdrawal) system, and with fan and water pump. It shall have the number cylinders and minimum displacement to achieve required brake horsepower rating at 1800 rpm. 
   a. Carburetor. 
   b. Fuel-shutoff solenoid valves: One for each fuel source. 
   c. Flexible fuel connectors: One for each fuel source. 
   d. Liquefied-petroleum (LP) gas source pressure shall be 7 to 11 inches H2O for proper operation.
E. Generator: Three-phase, single bearing, synchronous type built to NEMA MG 1 standards.

1. Alternator: Brushless, 4-pole, 2/3 pitch windings, 150 degrees C standard temperature rise. Class H insulation shall be used on the stator and rotor, and both shall be further protected with 100 percent epoxy impregnation and an overcoat of resilient insulating material on end coils to protect against fungus or abrasion. The alternator shall incorporate a resettable thermal protector for exciter/regulator protection. The alternator shall be twelve lead, wye connected.

2. Regulator: Permanent magnet excitation for power source to voltage regulators, solid-state controlled, exciter/regulator, matching the characteristics of the alternator and engine. Voltage regulation with adjustable electronic isochronous governor. Readily accessible voltage droop, voltage level, and voltage gain controls shall be provided. The solid state regulator module shall be shock mounted and epoxy encapsulated for protection against vibration and atmospheric deterioration.

3. The subtransient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

F. Mounting:

1. Structural steel sub-base and provided with suitable vibration isolators. Unit shall be capable of installation on concrete equipment foundation.

   a. Factory-mount engine-generator set and its auxiliary components and accessories, except the day tank and exhaust silencer, on a common base fabricated of structural steel sections. The structural base shall be of the heavy-duty skid type and shall have adequate strength and rigidity to maintain alignment of the equipment without a concrete foundation. Field-erect exhaust silencer as required. Piping to make a complete installation shall be provided as specified in Division 23. Steel used in fabrication of the mounting base shall be free from sharp bends and corners. Provide base and components with suitable lifting attachments. Locate attachments so that when the slings and lifting cables are attached, they will not harm exterior parts of the equipment.

G. Cooling system: Closed loop, liquid-cooled system with engine mounted radiator and blower type fan, sized to maintain safe operation at 104 degrees F (40 degrees C) maximum ambient temperature. The radiator shall be equipped for a duct adapter flange connected to exterior cabinet with flexible connection.

   1. Centrifugal jacket water pump: Built on the engine and driven from the engine crankshaft or camshaft, ample capacity to circulate the required flow of engine jacket water through the radiator to remove the total heat rejected from the engine to the jacket water and lubricating oil at 110 percent rated load in 104 degrees F (40 degrees
C) ambient while maintaining the optimum jacket water temperature leaving and entering the engine recommended by the engine manufacturer.

2. Thermostatic control valve: Shall maintain constant water temperature to the engine. Provide modulating type thermostatic valves using self-contained thermostats without external bulbs. Provide valves with one or more interchangeable thermostatic elements. Provide nonadjustable type thermostat with operating temperature factory set at the temperature recommended by the engine manufacturer. Design valve so that in event of thermostatic element failure it will fail safe, permitting water flow through the engine.

H. Fuel system: Liquefied-petroleum gas (LP).

1. Fuel system shall consist of the following tanks and fuel supplies:

I. Exhaust system:

1. Provide a silencer, including flexible exhaust fitting, properly sized and installed according to the manufacturer’s recommendation. Mounting shall be provided by the installing contractor. The silencer shall be mounted so that its weight is not supported by the engine.
   a. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer’s engine backpressure requirements.
      (1) Minimum sound attenuation of 25 dB at 500 Hz.
      (2) Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

2. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the generator set manufacturer.

J. Automatic starting system:

1. Starting motor: DC electric starting system with positive engagement drive. The motor voltage shall be as recommended by the engine manufacturer.
2. Automatic controls: Fully automatic generator set start-stop controls in the generator control panel. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, and overcrank; and one auxiliary contact for activating accessory items. Controls shall include a multi-cycle, cranking limit with lockout contacts for starting by switch on remote panel.

K. System accessories:
1. Jacket water heater: Unit mounted thermal circulation type water heater incorporating a thermostatic switch, capable of maintaining engine jacket water to 90 degrees F in ambient temperature of minus 10 degrees F. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

2. Starting and station batteries: Lead-acid or nickel-cadmium storage battery set of the heavy-duty starting type. 24Vdc battery voltage shall be compatible with the starting system. The battery set shall be of sufficient capacity to provide for 1 1/2 minutes total cranking time without recharging. Include a battery rack and necessary cables and clamps.

3. Battery charger: UL 1236 listed. Engine starting, current limiting battery charger to automatically recharge batteries. The charger shall have adjustable float and equalize voltage. DC amperage output shall be no less than 10 amperes. Output voltage shall be compatible with starting system. AC input voltage shall be 120V. Charger shall include fused overload protection; circuit breakers overcurrent protection; solid-state, silicon diode full wave rectifiers; voltage surge suppressors; DC voltmeter and AC ammeter; temperature voltage regulator; relays indicating AC power failure, low-, and high-battery voltage.

L. Generator control panel:

1. Type: Generator mounted NEMA 250 Type 1, vibration isolated, dead front, made of sheet metal gauge steel, with lockable hinged door.

2. Panel shall contain, but not be limited to, the following equipment:
   
   a. Voltmeter, 2 percent accuracy.
   b. Ammeter, 2 percent accuracy.
   c. Ammeter voltmeter, phase selector switch.
   d. Frequency meter, dial type. (45 - 65 Hz)
   e. Automatic starting controls.
   f. Voltage level adjustment rheostat.
   g. Dry contacts for remote alarms wired to terminal strips.
   h. Fault indicators for low oil pressure, high water temperature, overspeed, and overcrank.
   i. Three position selector switch with the following functions: auto, manual, off/reset.
   j. Emergency stop switch.
   k. Panel light.
   l. Running time meter
   m. Oil pressure and water temperature gauges


M. Generator output circuit breaker:
1. Type: Molded-case electronic trip type, 100 percent rated size as indicated on drawings. Circuit breaker shall conform to standards established by UL 489, and NFPA 70. Circuit breaker shall have long-time and short-time pick-up and delay, and instantaneous adjustable trip settings.

2. The circuit breaker trip curve shall be coordinated with alternator thermal damage curve as required by generator manufacturer data.
   a. Generator/exciter field circuit breakers do not meet the specified electrical standards and are unacceptable for line protection.

3. Shunt trip device: The shunt trip shall open the generator circuit breaker in the event of an engine shutdown signal, and shall operate from the cranking battery voltage.

4. Circuit breakers shall be lockable in the open position.

2.3 GENERATOR ENCLOSURE

A. Manufacturer’s standard enclosure: Prefabricated weather-resistant, sound attenuated enclosure sized to house the generator, sub-base fuel tank, battery charger, batteries, and required accessories. Enclosure shall be factory-assembled by the generator manufacturer.

B. Sheet metal steel enclosure primed with corrosion protection and painted with electrostatically-applied powder coat finish of manufacturer’s standard color. Enclosure shall include roof, side walls, and end walls. Hardware shall be stainless steel.

1. Lifting provisions: Capacity to support total assembly weight during rigging.

2. Access doors: Provide sufficient access for maintenance and operation from outside the enclosure.
   a. Handles key lockable, all doors keyed alike.

3. Air intake and sound attenuation louver openings shall be screened to limit entry of rodents.

4. Roof shall be designed to prevent collection of rainwater.

5. Provide factory-mounted exhaust silencer inside the enclosure. Exhaust shall exit the enclosure through a rain collar and terminate at a rain cap. Exhaust connections to the generator set shall be made with seamless flexible connections.

C. Sound attenuation: Enclosure shall be constructed to mitigate noise level to 85 dBA maximum at 23 feet (7 m) from enclosure at rated generator output.

D. Accessories:

1. Enclosure manufacturer shall provide the hardware required to mount the exhaust silencers while maintaining the enclosure’s weather resistance.
2.4  EXTERNAL VIBRATION ISOLATION DEVICES

A. Elastomeric isolator pads: Oil- and water-resistant elastomer, arranged in single or multiple layers, molded with a non-slip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Double layer, standard neoprene.

B. Restrained spring isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4 inch (6 mm) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Outside spring diameter: Not less than 80 percent of compressed height of the spring at rated load.

3. Minimum additional travel: 50 percent of 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.

C. Location: Isolators shall be provided between rails of generator set and supporting pad or structure.

2.5  REMOTE ALARM ANNUNCIATOR PANEL

A. Surface-mounted panel, complying with the requirements of NFPA 110, Level 1 equipment, providing visible and audible alarm signals powered by the storage battery of the generator. Unit enclosure: Fabricated of sheet steel, with removable front panel. The front panel shall contain LED type indicating lamps (visible signals) as listed below. The enclosure shall contain the required printed circuits, internal wiring, terminal block and battery voltage sensors. Provide knockouts for external wiring through bottom of box.

B. Provide on face of panel the following switches:

1. Lamp test pushbutton.


(See table, next page)
## LAMP LEGEND

<table>
<thead>
<tr>
<th>LAMP LEGEND</th>
<th>GENERATING SET CONDITION INDICATED</th>
<th>DERANGEMENT SIGNALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXERCISING</td>
<td>Generator exercising</td>
<td>Audible: No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>GENERATING</td>
<td>Generating Power to Load</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>OVERCRANK</td>
<td>Failed to Start</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>LOW ENG TEMP</td>
<td>Low Lube Oil Pressure</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>HI ENG TEMP PRE</td>
<td>Excessive Engine Temperature Pre-Alarm</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>HI ENG TEMP</td>
<td>Excessive Engine Temperature</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>LOW OIL PRESS PRE</td>
<td>Low Lube Oil Pressure Pre-Alarm</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>LOW OIL PRESS</td>
<td>Low Lube Oil Pressure</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>OVERSPEED</td>
<td>Engine Overspeed</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>LOW FUEL</td>
<td>Low Fuel Supply</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>LOW COOLANT</td>
<td>Low Engine Coolant Level</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>AUTO SWITCH</td>
<td>Control Switch Not in Automatic Position</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>LOW CRANK VOLT</td>
<td>Low Engine Cranking Voltage</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>LOW BATT VOLT</td>
<td>Low Battery Voltage</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>HI BATT VOLT</td>
<td>High Battery Voltage</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
<tr>
<td>ALARM CONTACT</td>
<td>Contacts for Common Alarm</td>
<td>Audible: Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visible: Yes</td>
</tr>
</tbody>
</table>

### 2.6 MONITORING SYSTEM

**A. Monitoring system:** Provide contacts from each generator for monitoring by the power monitoring system for the following functions:

1. Generator off.
2. Generator running.
3. Generator exercising.
4. Generator alarms: Overcrank, low oil pressure, high or low engine temperature, overspeed, batteries.
B. Provide control interface at the generator for monitoring the generator status through the building fire alarm system and building automation system.

2.7 SYSTEM OPERATION

A. Loss of normal power:

1. System is given signal to start by one of the automatic transfer switches or a remote device. Loss of power can occur at any automatic transfer switch, which can cause the generator to start. On receipt of this signal, generator shall automatically start, accelerate to rated frequency and build up to rated voltage.

2. Priority shall be set to actuate the automatic transfer switch designated in the following order:
   a. ATS-1: Life safety.
   b. ATS-2: General building stand-by.
   c. ATS-3: Mechanical stand-by.

3. After the first transfer switch closes to the bus, subsequent transfer switches shall close to the bus after pre-determined time delays.

B. Failure of generator to start:

1. If a unit fails to start, after the overcrank time delay (in the generator set control) has expired, the unit will be shut down, and an alarm will sound.

C. Return of normal power:

1. When normal power has been restored to the normal power system bus and sensed at each transfer switch, the loads shall be transferred back to normal source.

2. The generator shall operate until all transfer switches have returned to normal power switch position and operate at no load for a cool-down period. When the cool-down period has been completed, the generator shall shut down.

3. If a system start signal is received during the cool-down period, generator shall remain online and operate as described in “Loss of Normal Power” above.

D. Load bank testing: Provide an auxiliary distribution output circuit breaker as indicated on drawings for portable load bank testing of the generator. The circuit breaker shall be locked in the normally open position until a portable load bank is connected to the system.

1. Load bank test under normal power:
a. A keyed pushbutton device located adjacent the generator output breakers shall send a control signal to first open the main line circuit breaker and then close the auxiliary circuit breaker.

2. Loss of normal power:

   a. In the event the normal power source is lost, a signal shall be sent to the shunt trip operator to first open the auxiliary circuit breaker, immediately disconnecting the load bank, and then close the main line circuit breaker.

   b. The auxiliary circuit breaker will require manual resetting after the outage and restoration of normal operation.

2.8 SOURCE QUALITY CONTROL

A. Prototype testing: Perform factory performance tests using prototype generator of same engine model and alternative configuration, and assembled with like components and accessories. Provide three certified copies of the successful test reports.

   1. Tests: Comply with NFPA 110, Level 1, energy converters in Paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2.


   3. Equivalent components and accessories: Submit evidence that items furnished with the unit, but that are not identical to those on the prototype, are reliable and compatible with the application.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine rough-in requirements for connecting piping and wiring for the generator and verify conditions. Verify actual sizes and locations of connections are correct before packaged engine-generator installation.

3.2 PREPARATION

A. Battery equalization: Equalize charging of battery cells according to manufacturer’s written instructions.

3.3 INSTALLATION - GENERATORS

A. Install generators, complete with controls, accessories, enclosures, as indicated on the drawings and in accordance with manufacturer’s recommendations.

B. Comply with generator manufacturer’s written installation and alignment instructions and with NFPA 37 and 110.
C. Install the remote alarm annunciator panel where directed by the Owner unless otherwise indicated on drawings.

D. Set generators plumb and level on concrete base with vibration isolators. Secure to anchor bolts installed in the concrete base.

E. Install generators so as to provide access for maintenance and service, including removal of drivers and accessories.

F. Install piping, wiring, accessories, and appurtenances in accordance with the applicable specifications and manufacturers’ recommendations. Ground equipment.

G. Comply with applicable portions of NECA 404.

H. Generator and enclosure accessories shall be connected to the building electrical distribution system via branch circuits and feeders as indicated on drawings.

I. Verify proper fuel pressure for liquefied petroleum (LP) gas engines.

3.4 IDENTIFICATION

A. Materials: Refer to Section 26 05 53 for requirements on identification of electrical systems. Identify units, devices, fuse blocks, relays, controls, and wiring. Identify equipment ratings.

B. Nameplates: Refer to Section 26 05 53 for requirements on identification of electrical systems. Provide nameplate for each unit and associated components located on front of assembly.

C. Control components mounted within the assembly shall be identified with tags and other identification materials, and correspond to designations on manufacturer’s drawings.

D. Operating instructions: Provide fabricated frame on side of unit to house operating instruction manuals.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer’s field service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections; and to assist the Contractor in testing.

B. Tests and inspections:
1. Perform tests recommended by manufacturer. Perform electrical tests and visual and mechanical inspection for “AC Generators and or Emergency Systems” specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. NFPA 110 acceptance tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

3. Battery tests: Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer’s specifications.

4. Battery-charger tests: Verify specified rates of charge for both equalizing and float charging conditions.

5. System integrity tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks. Retain subparagraph below for long, restricted exhaust systems.

6. Voltage and frequency transient stability tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

7. Harmonic-content tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

8. Noise level tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

9. Exhaust emissions test: Comply with applicable government test criteria.

C. Coordinate generator testing with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
Brandywine Zoo
QUARANTINE SUPPORT BUILDING
June 2, 2020
Project Manual Division of Parks and Recreation Project No. WBZ-9

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units; retest and reinspect as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. The unit shall operate without undue noise or vibration, or excessive heating. Correct defects and retest until unit is operating satisfactorily.

K. Demonstrate satisfactory operation of each feature required of the generator set and accessories.

L. Test emergency power system: After completion and acceptance of the generator tests, perform an operational test of the emergency power system. Perform a power failure test on the emergency electrical system. This shall be performed by interrupting the normal power source and verifying proper generator start and transfer switch operation.

M. Report results of tests and inspections in writing. Record adjustable device settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 ACCEPTANCE TESTING

A. In addition to the factory and field tests required in Part 2, perform a scheduled on-site test and demonstration of the completely installed generator before making final electrical connections.

B. Test shall be witnessed by the Architect, Owner’s representative, and manufacturer’s representative. Manufacturer’s representative shall conduct demonstrations.

C. Provide and utilize load bank for testing. Load banks shall be capable of providing full load at 0.8 power factor.

D. Test procedures: Test the generator in accordance with NFPA 110 and as follows:

1. Test the generator for at least two hours under full load, starting and stopping at least five times.
   a. The unit shall operate without undue noise or vibration, or excessive heating. Correct defects and retest until unit is operating satisfactorily.
   b. Demonstrate satisfactory operation of each feature required of the generator set and accessories.
3.7  CLEANING

   A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish. Clean components internally using methods and materials recommended by the manufacturer.

3.8  OPERATING INSTRUCTIONS

   A. As specified in Section 26 05 00, provide operating instructions.

   B. Provide at least two sessions of four consecutive hours of additional instruction time for each system specified in this section.

END OF SECTION
SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Automatic transfer switches rated 600 V and less, including:
   1. Automatic transfer switch with open transition operation and microprocessor-based controls.

1.2 RELATED SECTIONS

A. Equipment Foundations: Section 26 05 28.

B. Identification of Electrical Systems: Section 26 05 53.

C. Overcurrent Protective Device Coordination Study: Section 26 05 73.


1.3 REFERENCES


B. UL 1008: Transfer Switch Equipment.

1.4 SUBMITTALS

A. Product data: Include assembly ratings and dimensioned plans, sections, and elevations showing minimum clearances, cable termination sizes, conductor entry, gutter space, installed features and devices, and material lists for each switch.

B. Bill of Materials: Provide detailed list of components.

C. Shop drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each transfer switch specified. Wiring diagrams showing detail wiring for transfer switch, differentiating between manufacturer-installed and field-installed wiring, and including power and control wiring.


D. Source quality-control test reports.
E. Field quality-control test reports.

F. Certifications:

1. Product certificate signed by manufacturer certifying that products furnished comply with requirements and that switches have been tested for applicable load ratings and short-circuit closing and withstand ratings.
2. Manufacturer's test reports showing that controllers meet the specified requirements.
3. Evidence that manufacturer, installer, and equipment meet the requirements specified in "Quality Assurance" below.

G. Operation and Maintenance Data: For transfer switches and associated components, provide product data, shop drawings, and test reports in operation and maintenance manual. In addition to items specified in Division 01 Section “Operation and Maintenance Data,” include the following:

1. Features and operating sequences, both automatic and manual

1.5 QUALITY ASSURANCE

A. Transfer switches shall comply with UL 1008. Where specified requirements exceed requirements of UL 1008, switch shall meet the stricter requirements.

B. Automatic transfer switch and bypass/isolation switch shall be manufactured by the same manufacturer. Design shall have been in production for not less than 10 years, with at least 100 installations operating successfully.

1. Manufacturer shall maintain records of each switch, by serial number, for no less than 20 years.

C. Qualifications of manufacturer: Maintain a factory-authorized service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

D. Qualifications of supplier/installer:

1. Staff factory-trained and -authorized in the installation, testing, and operation of the specified equipment.
2. Provides emergency service on call 24 hours a day, seven days a week.
3. Maintains an adequate stock of manufacturer's genuine or approved parts to service this equipment.
4. Has service contracts available which can meet requirements specified for the equipment of this project.
1.6 COORDINATION

A. Coordinate layout and installation of switches and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases.

C. Coordinate location of underslab conduit.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store switches indoors in clean dry space with uniform temperature to prevent condensation. Protect switches from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 WARRANTY

A. Special warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of transfer switch and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty period: Five years from date of substantial completion.
2. Warranty shall include all parts and labor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide products manufactured by Kohler Power Systems, or comparable product by one of the following:

1. General Electric / Zenith Controls, Inc.
2. Onan/Cummins Power Generation
3. Russelectric, Inc.

2.2 GENERAL TRANSFER SWITCH REQUIREMENTS

A. Equipment shall be based on the following: 208/120 volts, 3-phase, 4-pole; Level 1 equipment according to NFPA 110; rated in accordance with UL 1008 for continuous loading and total system transfer; suitable for motor, resistance heating, electric-discharge lighting, and tungsten filament lamp loads. Unit ratings involving ampacity, number of poles, and withstand close rating are indicated on drawings.
B. Tested Fault-Current Closing and Withstand Ratings (3 cycles): Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Provide transfer switches with withstand ratings based on available fault current determined by Short-Circuit Analysis performed under Section 26 05 73 or as indicated on one-line diagram, whichever is larger.

C. Neutral Switching. Provide neutral pole switched simultaneously with phase poles on four-pole transfer switches.

D. Oversize Neutral: Ampacity and switch rating of neutral path through units shall be double the nominal rating of the switch.

E. Enclosure: NEMA 250, Type 1; NEMA ICS 6; and UL 508.

F. Terminal block: Termination of all auxiliary contacts, switches, pilot lights, and appurtenances mounted in transfer switch enclosure.

G. Clearly label and identify each indicating light and switch as to its purpose or function.

2.3 AUTOMATIC TRANSFER SWITCH

A. Ratings: Unit ratings involving ampacity, number of poles, and withstand close rating are indicated on drawings.

B. Switching arrangement:

1. Delayed, Open Transition Transfer Operation: Double-throw design, with break-before-make capability. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs.

   a. External manual operator switch.

2. Switch Characteristics:

   a. Designed for continuous-duty, repetitive transfer of full-rated current between active power sources.
   b. The contact driving system shall be mechanically held and electrically operated by a single motor operator.
   c. Contacts: Silver alloy, capable of making or breaking any load within the rating of the switch.
(1) Contacts that close to start the engine generator: Include a time delay of transfer switch and engine starting signals, factory set at 5.0 seconds (adjustable from 0-5 minutes).

d. Interlocked, molded case circuit breakers or contactors are not acceptable.

C. Controls: Microprocessor-based controller integrally mounted in the transfer switch with all components and wiring accessible from the front.

1. Tested and rated as follows:

   a. For storage at temperatures from minus 25 to plus 85 degrees C.
   b. For operation:

      (1) At minus 20 to plus 70 degrees C.
      (2) At 0 to 99 percent humidity, non-condensing.
      (3) Withstands infinite power interruptions.
      (4) Withstands surges when tested in accordance with ANSI/IEEE C37.90.1.

2. Include a real-time clock with nickel-cadmium battery backup.

3. Monitoring: On both normal and emergency sources, include three-phase over or under voltage, over or under frequency, and phase sequence detection, and phase differential monitoring.

4. Communications: Industry standard open-architecture communication protocol for high-speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4000 feet of cable, or farther with the addition of a communication repeater.

   a. Serial communication port: RS422/485 compatible

5. Self-diagnostics: Shall perform periodic checks of the memory I/O and communications circuits, with a power failure circuit.

6. Password protection shall limit access to designated personnel.

7. Operation: Keypad with multi-character liquid crystal display.

8. Memory / Flash-backup: Accessible both locally and from remote controller, including:

   a. Number of hours transfer switch has been in the emergency position (total since reset).
   b. Number of transfers in either direction (total since reset).
   c. Date, time, and description of the last 4 source failures.
   d. Date of the last exercise period.
   e. Date the record was reset.
D. Provide close differential voltage sensing of all phases of both the normal and alternate sources of power. Factory settings preset for:

1. Dropout at 87 percent of nominal voltage (adjustable 75-98 percent)
2. Pickup at 95 percent of nominal voltage (adjustable 85-100 percent).

E. The transfer of the load shall occur only if the alternate source has attained factory setting of 95 percent of nominal voltage (adjustable 85-100 percent) and 95 percent of nominal frequency (adjustable 90-100 percent) and the transfer to alternate time delay has expired. The time delay shall be factory set for 5 seconds and adjusted in the field to comply with system priority requirements outlined in Part 2 below. (Field-adjustable range of 0 to 2 minutes.)

   1. Upon return of the normal source to within the limits of the voltage sensor, the switch shall retransfer to the normal source after a retransfer to normal time delay. The time delay shall be factory preset for 15 minutes. (Field-adjustable range of 0.5 to 30 minutes.) Retransfer shall be a closed-transition operation. A synch-check function shall confirm synchronization prior to retransfer.

F. Time delay for engine generator cooldown: Unloaded, running, factory-set at 5 minutes (adjustable 0-5 minutes).

G. Indicating lights: LED type. Green, indicating that the normal source is connected to the load, and red, indicating that the alternate source is connected to the load.

H. Test switch: Simulates a normal source outage.

I. Reset switch: To manually retransfer the automatic transfer switch to the normal source, except that retransfer shall occur automatically if alternate source fails.

J. In-phase monitor control for transfer and retransfer of motor loads.

K. Automatic exerciser with load for 0.5 hour monthly. The automatic exerciser function shall be enabled in one transfer switch selected by the Owner.

L. Relay protection:

   1. Full-phase voltage on normal side.
   2. Three-phase voltage frequency on generator side.

M. Auxiliary contacts: Provide number of sets of auxiliary contacts necessary to initiate generator starting and interface with Owner monitoring system.

N. The transfer switch shall have the following programming functions available:
1. Block transfer to emergency source.
2. Load shedding.
3. Peak-shaving.

O. The transfer switch shall control the load functions.

2.4 MONITORING SYSTEM

A. Provide contacts from each automatic transfer switch for monitoring by the power monitoring system for each of the following functions.

1. Switch in normal position.
2. Switch in emergency position.
3. Switch in maintenance bypass position.
4. Normal power available.
5. Emergency power available.

2.5 TRANSFER SWITCH OPERATION AND EMERGENCY SYSTEM PRIORITY

A. Priority Status: Transfer switch priority shall apply as follows:

1. ATS-1: Life safety.
2. ATS-2: General building standby.
3. ATS-3: Mechanical standby.

B. Transfer to Generator Source: Switches shall transfer to emergency power source in order of priority status listed above. In the event that the emergency source cannot generate enough capacity to carry the total emergency system load, switches shall transfer in decreasing order of priority until system capacity is reached. Switches can later be transferred to the emergency source if additional capacity is available. Field adjust the time delay settings to achieve system transfer of loads as follows:

1. ATS-1: Use factory setting or 5 seconds, whichever is less. Total system transfer time shall not exceed 10 seconds per NFPA 110.
2. ATS-2: General building standby: Time delay: 20 seconds.
3. ATS-3: Mechanical standby: Time delay: 45 seconds.

C. Generator Failure: In the event generator system power is not sufficient to carry the loads of each emergency branch, transfer switches shall open and shed load in reverse priority order.

D. Transfer Back to Normal Source: Switches shall transfer back to normal source in reverse priority order as follows:
1. Delayed, Open Transition Operation – When the normal source has been restored and is within the pre-selected ranges for voltage and frequency, and after an adjustable time delay to ensure the integrity of the normal power source, the load shall be transferred back to normal source in a break-before-make transfer scheme. The generator set will continue to run for a user adjustable time to allow the generator set to run unloaded for cool down, after which the engine will be shut down. Upon completion, the system will then be ready for automatic operation.

2.6 SOURCE QUALITY CONTROL

A. Factory-test components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test in accordance with NEMA ICS 1.

B. As a condition of approval, the manufacturer of the automatic transfer switches shall verify that their switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3-cycle short circuit closing and withstand as follows:

<table>
<thead>
<tr>
<th>RMS Symmetrical Amperes 480 VAC</th>
<th>Current Limiting Fuse Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amperes</td>
<td>Closing and Withstand</td>
</tr>
<tr>
<td>100-400</td>
<td>42,000</td>
</tr>
<tr>
<td>600-800</td>
<td>65,000</td>
</tr>
<tr>
<td></td>
<td>200,000</td>
</tr>
</tbody>
</table>

Where available fault current levels, as determined by Short-Circuit Analysis, exceed closing and withstand ratings listed above, provide integrally mounted current-limiting fuses to meet this rating.

C. During the 3-cycle closing and withstand tests, there shall be no contact welding or damage. The 3-cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contacts separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc.

D. When conducting temperature rise tests to UL-1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the combination transfer bypass/isolation switch to carry full rated current after completing the overload and endurance tests.

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
PART 3 – EXECUTION

3.1 INSTALLATION

A. Install transfer switches on concrete equipment foundations (housekeeping pad).
   1. Anchor equipment to concrete housekeeping pad according to manufacturer’s written instructions, and requirements in other sections of Division 26.
   2. Install each unit level and plumb.

B. Maintain minimum clearances and workspace at equipment according to manufacturer’s written instructions and NFPA 70.

C. Install in accordance with national, state, and local codes, and manufacturer's instructions.

D. Include items not specifically mentioned but necessary for proper operation.

E. Connect wiring as indicated on the drawings and in accordance with manufacturer's recommendations.

F. Identify components.

3.2 CONNECTIONS

A. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical Systems.”

B. Wiring to Remote Components: Provide type and number of cables and conductors in raceway as recommended by manufacturer between emergency distribution system components for control and communication requirements.

3.3 IDENTIFICATION

A. Materials: Refer to Division 26 Section "Identification of Electrical Systems." Identify units, devices, fuse blocks, relays, controls, and wiring. Identify equipment ratings.

B. Nameplates: Refer to Division 26 Section “Identification of Electrical Systems” for additional requirements. Provide nameplate for each switch and major control or display component located on front of assembly.

   1. Furnish master nameplate, stamped metal, listing standard manufacturer information including voltage, ampere, frequency, and short-circuit ratings; manufacturer’s model and project designations.
C. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be identified corresponding to designations on manufacturer’s drawings using tags and other identification materials.

3.4 FIELD QUALITY CONTROL

A. Test transfer switches and components by operating them in all modes. Perform tests recommended by manufacturer under supervision of manufacturer’s factory-authorized representative. Tests shall include simulation of building power outages to verify coordination of transfer timing sequences with switchgear.

B. Correct deficiencies and report results in writing. Record adjustable relay settings.

C. Coordinate tests with tests of generator plant and run them concurrently.

3.5 CLEANING

A. Inspect and clean surfaces and repair damaged finishes to match original finish.

B. Clean interior of equipment according to manufacturer's instructions.

3.6 OPERATING INSTRUCTIONS

A. As specified in Section 26 05 00, provide operating instructions.

B. Provide a period of 4 hours for equipment instruction to operating personnel.

C. Coordinate this instructional training with that for generator equipment.

END OF SECTION
SECTION 26 43 13 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surge protective devices (SPD's) for the protection of ac electrical circuits from the effects of lightning-induced currents, substation switching transients, and internally generated transients resulting from inductive or capacitive load switching.

1.2 RELATED SECTIONS

A. Service entrance: Section 26 05 41.
B. Panelboards: Section 26 24 16.

1.3 DEFINITIONS

A. LED: Light-emitting diode.
B. MCOV: Maximum continuous operating voltage.
C. MOV: Metal-oxide varistor.
D. SPD: Surge protective device.
E. VPR: Voltage protection rating.

1.4 SUBMITTALS

A. Product data: Manufacturer’s catalog information, including unit dimensions and rated capacities for each type of unit included in the project.

B. Certifications:
   1. Cover page of manufacturer’s UL test report for each type of unit, showing that the unit is UL 1449 Fourth Edition listed.
   2. UL 1449 Fourth Edition listing documentation verifying the following:
      a. Voltage protection rating (VPR).
      b. Maximum continuous operating voltage (MCOV).
   3. Electromagnetic interference certification in accordance with UL 1283.
1.5 QUALITY ASSURANCE

A. Each SPD shall be UL 1449 Fourth Edition listed and labeled.

B. A single manufacturer shall provide SPD’s for every location, except at switchboard.

1.6 WARRANTY

A. In addition to the general project warranty and correction period, provide manufacturer’s special warranties providing unlimited replacements of suppressor modules if they are destroyed by transients. Length of warranties:

1. Service entrance SPD: Ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide externally mounted SPD units manufactured by ASCO Power Technologies, or comparable product by one of the following:

1. ASCO Power Technologies.
2. Eaton Corporation.
5. Schneider Electric; Square D products.
7. Surge Suppression Inc.

B. Service entrance SPD’s: Basis-of-design product: Subject to compliance with requirements, provide SPD units integral to service entrance equipment manufactured by Eaton, or comparable product by one of the following:

1. Eaton Corporation.
2. General Electric Company.
3. Schneider Electric; Square D products.
4. Siemens Industry, Inc.

C. Distribution equipment SPD’s: Basis-of-design product: Subject to compliance with requirements, provide SPD units integral to distribution equipment manufactured by ASCO Power Technologies, 400 Series, or comparable product by one of the following:

1. ASCO Power Technologies.
2. Eaton Corporation.
5. Schneider Electric; Square D products.
7. Surge Suppression Inc.

2.2 SERVICE ENTRANCE SURGE PROTECTIVE DEVICE

A. Service entrance SPD unit factory installed and mounted integral to the service entrance distribution panelboard as specified in Section 26 24 16, Panelboards.

B. Suppression components shall be MOV based, serviceable, and replaceable.

C. SPD shall provide surge current paths for the following modes of protection: L-N, L-G, L-L, and N-G.

D. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz.

E. Provide terminals for the necessary power and ground connections. Each terminal shall accommodate wire sizes of No. 10 to No. 1 AWG.

F. SPD shall meet or exceed the following criteria:

1. Surge current capacity, single pulse rated (L-N + N-G): 150 kA per phase (8/20 μs waveform).
2. The UL 1449 Fourth Edition; voltage protection ratings (VPR) shall not exceed the following:

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>L-N</th>
<th>L-G</th>
<th>L-L</th>
<th>N-G</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120V</td>
<td>700V</td>
<td>800V</td>
<td>1200V</td>
<td>700V</td>
</tr>
</tbody>
</table>

3. UL 1449 listed maximum continuous operating voltage (MCOV):

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Allowable System</th>
<th>Voltage Fluctuation</th>
<th>MCOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120V</td>
<td></td>
<td>25 percent</td>
<td>150V</td>
</tr>
</tbody>
</table>

G. SPD shall be equipped with the following:

1. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.

H. Enclosure: NEMA 250 Type 1.
2.3 SURGE PROTECTIVE DEVICES FOR SECONDARY DISTRIBUTION PANELS AND BRANCH CIRCUIT PANELBOARDS

A. SPD unit externally mounted and field wired to the panelboard as specified in Section 26 24 16, Panelboards. SPD integral to the panelboard shall not be acceptable.

B. Suppression components shall be MOV based, serviceable, and replaceable.

C. SPD shall provide surge current paths for the following modes of protection: L-N, L-G, L-L, and N-G.

D. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz.

E. Provide terminals for the necessary power and ground connections. Each terminal shall accommodate wire sizes of No. 10 to No. 1 AWG.

F. SPD’s shall meet or exceed the following criteria:

1. Surge current capacity, single pulse rated, (L-N + N-G):
   a. For power distribution panelboards: 100 kA per phase.
   b. For branch-circuit panelboards: 100 kA per phase.

2. The UL 1449 Fourth Edition; voltage protection ratings (VPR) shall not exceed the following:

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>L-N</th>
<th>L-G</th>
<th>L-L</th>
<th>N-G</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120V</td>
<td>700V</td>
<td>800V</td>
<td>1200V</td>
<td>700V</td>
</tr>
</tbody>
</table>

3. UL 1449 listed maximum continuous operating voltage (MCOV):

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Allowable System</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120V</td>
<td>Voltage Fluctuation</td>
</tr>
<tr>
<td></td>
<td>25 percent</td>
</tr>
<tr>
<td></td>
<td>MCOV</td>
</tr>
<tr>
<td></td>
<td>150V</td>
</tr>
</tbody>
</table>

G. SPD shall be equipped with the following:

1. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.

H. Enclosure: NEMA 250 Type 1.

PART 3 - EXECUTION
3.1 INSTALLATION, GENERAL

A. Install per manufacturer’s installation instructions and recommendations.

B. Install SPD's plumb, level and rigid without distortion.

3.2 INSTALLING SERVICE ENTRANCE SURGE PROTECTIVE DEVICE

A. Install one primary SPD at each utility service entrance to the facility as shown on the drawings.

B. Install the SPD on the load side of the main service disconnect.

C. Keep conductors between the SPD and point of attachment short and straight.

D. Bond SPD’s ground to the service entrance ground.

3.3 INSTALLING SURGE PROTECTIVE DEVICES FOR PANELBOARDS

A. Install SPD external to branch panelboards.

B. Install per manufacturer’s installation instructions with lead lengths as short (less than 24 inches) and straight as possible.

  1. Rearrange circuit breaker locations in panelboards to ensure short and straightest possible leads to each SPD.

3.4 ADJUSTMENTS AND CLEANING

A. Remove debris from SPD and wipe dust and dirt from all components.

B. Repaint marred and scratched surfaces with touch up paint to match original finish.

3.5 FIELD QUALITY CONTROL

A. Test and inspections:

  1. Perform each visual and mechanical inspection and electrical test in accordance with NETA Acceptance Testing Specifications in section, Surge Arresters, Low-Voltage Surge Protection Devices. Certify compliance with test parameters.

  2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.

  3. Complete startup procedures according to manufacturer’s written instructions.
B. SPD device shall be considered defective if it does not pass tests and inspections.

END OF SECTION
SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting fixtures, including lamps, drivers, and accessories.

B. Emergency lighting control transfer relay device.

1.2 RELATED SECTIONS

A. Dimming control: Section 26 09 23.

B. Occupancy sensors: Section 26 09 23.

1.3 SUBMITTALS

A. Product data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures, photometrics and efficiency, wattage, reflectors, glassware, voltage, suspension, and appurtenances.
2. Certified results of laboratory tests for fixtures and lamps for photometric performance.
3. Emergency lighting unit battery and charger.
4. LED drivers.
5. Lumen output, rated color temperature, and manufacturer’s LED binning procedures.
6. Types of lamps.

B. Maintenance data: For lighting fixtures to include in maintenance manuals specified in Division 01.

C. Warranties: Special warranties specified in this section.

1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 26 05 00, Common Work Results for Electrical.

B. Fixtures, emergency lighting units, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

C. Comply with NFPA 70.
D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

A. Fixtures, mounting hardware, and trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver glassware and lamps in their original cartons, clearly labeled.

1.7 WARRANTY

A. Special warranty for batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special warranty period for batteries: Manufacturer’s standard, but not less than 5 years from date of substantial completion. Full warranty shall apply for first year, and prorated warranty for last four years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design products: Fixtures indicated in the Fixture Schedule on the drawings are the basis of design of the project.

1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to Bidding and Contracting requirements and Division 01 requirements for substitutions.

B. Subject to compliance with requirements, provide products by one of the following:

1. Drivers:
   a. Philips/Advance
   b. Osram Sylvania
   c. Universal Lighting Technologies
   d. Lutron
   e. EldoLED

2.2 FIXTURES, GENERAL
A. Fixtures shall comply with UL 1598 and be complete with sockets, casings, fittings, holders, shades, glassware, lamps, and appurtenances, wired and completely assembled.

B. Metal parts: Free from burrs, sharp corners, and edges.

C. Sheet metal components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, frames, and other internal access: Smoothly operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling and when secured in operating position.

E. Metal finishes: Painted after fixture fabrication.

F. Reflecting surfaces: Minimum reflectance as follows, unless otherwise indicated:
   1. White surfaces: 85 percent.
   2. Specular surfaces: 83 percent.
   3. Diffusing specular surfaces: 5 percent.
   4. Laminated silver metalized film: 90 percent.

G. Lenses, diffusers, covers, and globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated, exactly as scheduled or specified in optical details and lighting characteristics.
   1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
   2. Lens thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 LED DRIVERS

A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED lamp sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller.

C. Performance Criteria:
   1. Driver shall have a Class A sound rating.
   2. Driver shall have a power factor (PF) greater than 0.90.
   3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.
D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.

E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.4 EXIT SIGNS

A. General requirements: Exit signs shall meet the Energy Star Program requirements to operate on 5 W or less input power per face. Comply with UL 924 and the following:

1. Sign colors and lettering size: Comply with authorities having jurisdiction.

B. Internally lighted signs: As follows:

1. Lamps for ac operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.

C. Self-powered exit signs (battery type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.5 EMERGENCY LIGHTING UNITS

A. General requirements: Self-contained units. Comply with UL 924. Units include the following features:

1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when 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, and battery is automatically recharged and floated on charger.
4. Integral time-delay relay: Arranged to hold unit on for fixed interval after restoring power after an outage. Provides adequate time delay to permit high-intensity-discharge lamps to restrike and develop adequate output.

2.6 LAMPS
A. Lamps, LED:

1. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the lighting fixture manufacturer.
2. LED lamps shall be integrated into an engineered package for the specific lighting fixture application, including heat dissipation components.
3. Color temperature: As specified in lighting fixture schedule, with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variation between adjacent lighting fixtures shall be considered a failure to meet these specifications and shall be replaced at no cost to the owner.
4. Minimum performance characteristics:
   a. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
   b. Lumen Output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.
   c. Color Rendering Index: Rated at 85 or higher.

2.7 FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 05 00, Common Work Results for Electrical, for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-stem hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-stem hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft cable support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.8 FINISHES

A. Fixtures: Manufacturer’s standard, unless otherwise indicated.

   1. Paint finish: Applied after fabrication over corrosion-resistant treatment or primer, free of defects.
PART 3 - EXECUTION

3.1 PREPARATION

A. Before ordering the light fixtures, consult with the installer of the ceilings to ensure that the correct fixture trim is supplied and installed. Provide the supports and accessories required for installation in each ceiling system.

B. Before ordering the light fixtures, verify the specified voltage with the voltage shown on the drawings to ensure the correct voltage is supplied.

3.2 INSTALLATION

A. Furnish and install a complete lighting fixture for every outlet indicated on the drawings so that every outlet shall be properly provided with a suitable fixture of type specified, of wattage indicated.

B. Fixture wire shall bear UL label. Fixture wiring for fixtures and branch circuit wiring in fluorescent fixture channels shall be type THHN.

C. Each fixture shall be completely equipped with lamps of the size, type, wattage and shape indicated and specified. Lamps shall be of the proper voltage for the building.

D. Furnish fixtures in the quantities, sizes, and types indicated on drawings.

E. Where a letter designating fixture type is adjacent to a row of fixtures, it shall be understood that all fixtures in the row shall be of this type, consisting of either four-foot or eight-foot units, the rows consisting of the total lengths indicated. Where the catalog numbers of the fixtures refer to 4-foot units, 8-foot units may be used where applicable.

F. Provide recessed fixtures with flexible conduit connector and wire (fixture whip), or a removable wiring access plate, so that they may be wired without removing cover. Plate shall be screwed to fixture housing and conduit shall be securely attached and grounded to fixture to meet NEC requirements.

3.3 FIXTURE SUPPORT

A. Support from building structure: Provide fasteners appropriate to the supporting substrate, and wire, jack chain, or rods as specified for particular fixture types below.

   1. Provide channels bolted or welded between joists where required to obtain proper spacing for lighting supports.
   2. Connections to joists or beams: Beam clamps. For wire supports, wrap wire securely around structural member.
3. Connections to concrete: Embedded, as specified in Section 26 05 33, Conduits.

B. Where it is necessary for a fixture to be installed directly below an air duct, install two hanger rods, one on each side of the duct, bolted to a channel or angle suspended from the hangers under the duct, and support the fixtures from the suspended channel or angle.

3.4 CLEANING

A. Light fixtures, used for temporary lighting during construction, shall be cleaned free of construction dirt to like-new condition, and re-lamped with the specified lamps.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Poles
B. Fixtures

1.2 RELATED SECTIONS

A. Conduits: Section 26 05 33.
B. Wires and cables: Section 26 05 19.
C. Equipment foundations: Section 26 05 28.
D. Excavation and fill for electrical work: Section 26 05 01.

1.3 DEFINITIONS

A. Bracket: An attachment to a standard, on which a luminaire is carried.
B. Luminaire: A lighting device consisting of a light source together with its direct appurtenances, including globe, reflector, refractor, housing, and such support as is integral with the housing. The standard and the bracket are not part of the luminaire.
C. Pole: A support generally used to carry overhead lighting distribution circuits.
D. Standard (lamp post): A support used to carry a luminaire, provided with
   1. Internal attachments for wiring and
   2. External attachments for brackets (if any) and luminaire.

1.4 SUBMITTALS

A. Product data: Submit for each type of fixture, pole and standard.
   1. Type
   2. Wattage
   3. Voltage
   4. Efficiency
   5. Suspension
6. Glassware  
7. Finished diameters  
8. Mounting heights  
9. Lamps  
10. LED drivers  
11. Appurtenances

1.5 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 26 05 00, Common Work Results for Electrical.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver glassware and lamps in their original cartons, clearly labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design products: Fixtures indicated in the Fixture Schedule on the drawings are the basis of design of the project.

1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to bidding and Contracting requirements and Division 01 requirements for substitutions.

B. Subject to compliance with requirements, provide products by one of the following:

1. LED drivers:
   a. EldoLED  
   b. Lutron  
   c. Osram Sylvania  
   d. Philips/Advance  
   e. Universal Lighting Technologies

2. Lamps:
   a. General Electric  
   b. Osram Sylvania  
   c. Philips  
   d. Venture

2.2 CONCRETE
A. Concrete shall be 3,000 psi strength.

2.3 EXTERIOR LIGHTING FIXTURES

A. Provide lighting fixtures of sizes, types, and ratings scheduled, complete with, but not limited to, housings, energy-efficient drivers, starters, and wiring.

B. Exterior light fixtures shall be Dark Skies Compliant.

2.4 LED DRIVERS

A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED lamp sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller.

C. Performance criteria:

1. Driver shall have a Class A sound rating.
2. Driver shall have a power factor (PF) greater than 0.90.
3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.

D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.

E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.5 LAMPS

A. Lamps, LED:

1. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the lighting fixture manufacturer.
2. LED lamps shall be integrated into an engineered package for the specific lighting fixture application, including heat dissipation components.
3. Color temperature: As specified in lighting fixture schedule, with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variations between adjacent lighting fixtures shall be considered a failure to meet these specifications and shall be replaced at no cost to the Owner.
4. Minimum performance characteristics:

   a. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
b. Lumen output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.

c. Color rendering index: Rated at 85 or higher.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install poles, accessories, and fixtures as indicated, in accordance with manufacturer’s written instructions, applicable requirements of NFPA 70, NESC and NEMA standards, and with recognized industry practices.

3.2 ADJUSTING AND CLEANING

A. Clean lighting fixtures of dirt and debris upon completion of installation.

B. Protect installed fixtures from damage during construction period.

3.3 DEMONSTRATION

A. Upon completion of installation of exterior lighting fixtures, and associated electrical supply circuitry, apply electrical energy to circuitry to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION
SECTION 28 31 00 - FIRE DETECTION AND ALARM SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide a complete fire detection and alarm system of the noncoded, addressable, analog type, with manual stations, detectors, notification appliances, controls, and devices.

B. Costs of certification and testing, including tests required by NFPA 72, shall be included in the contract sum.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Duct smoke detectors: Section 23 09 13.

1.3 DEFINITIONS

A. FACP: Fire alarm control panel.

B. HVAC: Heating, ventilation, and air-conditioning.

C. LED: Light-emitting diode.

D. SPDT: Single pole, double throw.

E. Definitions in NFPA 72 apply to fire alarm terms used in this section.

1.4 SYSTEM DESCRIPTION

A. Control of system: By the FACP.

B. System supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

C. Priority of signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.

D. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.
E. System reset: All zones are manually resettable from the FACP after initiating devices are restored to normal.

F. Transmission to remote alarm receiving station.

G. System alarm capability during circuit fault conditions: System wiring and circuit arrangement prevent alarm capability reduction when a single ground occurs in an initiating device circuit, signal line circuit, or notification-appliance circuit.

H. Loss of primary power at the FACP initiates a trouble signal at the FACP. The FACP indicates when the fire alarm system is operating on the secondary power supply.

I. Basic alarm performance requirements: Unless otherwise indicated, operation of a manual station or automatic alarm operation of a smoke detector, initiates the following:

1. Notification-appliance operation.
2. Identification at the FACP of the zone and device originating the alarm.
3. Shutdown of fans and other air-handling equipment serving zone where alarm was initiated.
4. Operation of duct smoke detector shall initiate a supervisory signal and shutdown of fans and other air-handling equipment serving zone where alarm was initiated.
5. Recording of the event in the system memory.
6. Initiate the transmission of alarm to the Owner's remote alarm receiving station.

J. Alarm silencing, system reset and indication: Controlled by switches in the FACP.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset. System reset shall be controlled only at the FACP.

K. Remote detector sensitivity adjustment: Manipulation of controls at the FACP causes the selection of specific addressable, analog smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory.

L. Removal of an alarm-initiating device or a notification appliance initiates the following:
1. Transmission of trouble signal to remote alarm receiving station.

M. FACP alphanumeric display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

1.5 SUBMITTALS

A. General:

1. When approved, no variation will be permitted except with the approval of the Architect.
2. Submit to the authority having jurisdiction and to the Architect for review and approval.

B. Shop drawings:

1. Floor plans indicating final equipment and device locations and raceway routes.
2. System operation description: Detailed description for this project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
3. Wiring diagrams and floor diagrams.

C. Product data: Schedule and each type of system component, including dimensioned plans and elevations showing minimum clearances and installed features and devices. Include UL listings.

D. Battery calculations.

E. Provide a complete project record drawing as specified in Division 01 and Section 26 01 01 showing the location of all the outlets, cable taps, cable routes, and other components installed. Drawings shall be made part of Operating and Maintenance Manuals.

F. Certifications:

1. UL Certificate of Compliance of system supplier as specified in "Quality Assurance" below.
2. Fire and smoke detection system inspection and test report, completed by the factory representative, endorsed by the Owner and the factory representative, including test data, detector locations and serial numbers, a summary of maintenance performed, recommendations for relocation or addition of detectors and final action regarding these recommendations, and system certification.
1.6 QUALITY ASSURANCE

A. System and equipment shall be UL listed. Each major component shall bear the manufacturer's name and catalog number.

B. UL labels and local testing (if required): As specified in Section 26 05 00, Common Work Results for Electrical.

C. Single-source responsibility: Obtain system components from a single source who assumes responsibility for their compatibility.

D. Qualifications of system supplier and installer:

1. Staff shall consist of at least one NICET Level II Technician or a professional engineer registered in Delaware.
2. Has installed at least ten systems of the type specified which have performed satisfactorily for not less than two years.
3. Maintains a facility with a sufficient stock of spare parts.
4. Shall respond within 24 hours of notification to correct system failure or malfunction. During the project correction period defined in General Conditions and in Section 26 05 00, perform such corrections at no addition to the Contract Sum.

E. Factory-authorized service representative: Trained and certified by the manufacturer of the system, and experienced in the installation and operation of the type of system included in the work.

F. Comply with NFPA 72, applicable local codes, and regulations and requirements of the authorities having jurisdiction. Wilmington, Delaware is the local code authority.

1.7 INSPECTIONS AND SERVICE CONTRACT

A. During the general project correction period, every six months starting six months after Substantial Completion, the supplier shall inspect and test the system.

1. Submit written reports to the Owner and Architect, describing test results, including defects found and how they have been corrected, and listing components replaced.

B. At the end of the correction period, offer the Owner a service contract for the complete system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Basis-of-design system: Subject to compliance with requirements, provide system by Edwards Systems Technology, (EST) Inc. (United Technologies) or comparable system by one of the following:

1. Edwards (EST); United Technologies
2. Notifier; Honeywell
4. Silent Knight; Honeywell
5. SimplexGrinnell

2.2 CENTRAL FACP

A. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or for normal maintenance of the system are performed from the front of the enclosure. If more than one unit is required to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.

1. Mounting: Surface.

B. Alarm and supervisory systems: Modules replaceable without removal of field wiring.

C. Control modules: Include types and capacities required to perform all functions of fire alarm systems.

D. Indications: Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.

E. Resetting controls: Prevent the resetting of alarm, supervisory, or trouble signals while the alarm or trouble condition still exists.

F. Alphanumeric display and system controls: Arranged for interface between human operator at the FACP and addressable system components, including annunciation, supervision, and control.

1. Display: A minimum of 80 characters; alarm, supervisory, and component status messages; and indicate control commands to be entered into the system for control of smoke detector sensitivity and other parameters.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

2.3 EMERGENCY POWER SUPPLY

A. General: Components include nickel-cadmium battery, charger, and an automatic transfer switch.
1. Battery nominal life expectancy: 20 years, minimum.

B. Battery capacity: 24 hours of supervisory power with 5 minutes of general alarm capability at end of 24 hours.

C. Battery charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.

D. Integral automatic transfer switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.4 SMOKE DETECTORS

A. General: UL 268A listed. Include the following features:

1. Operating voltage: 24-V dc, nominal.
2. Self-restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
3. Plug-in arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed base with a twist-locking plug connection. Terminals in the fixed base accept building wiring.
4. Integral visual-indicating light: LED type. Indicates detector has operated.
5. Sensitivity: Can be tested and adjusted in-place after installation.
6. Integral addressable module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
7. Remote controllability: Unless otherwise indicated, detectors are analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

a. Detectors which will be installed in ducts or other concealed locations shall be capable of being tested from an indicating and test station specified below.

B. Photoelectric smoke detectors: Include the following features:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
3. Integral thermal detector: Fixed-temperature type with 135 deg F (57 deg C) setting.

C. Ionization smoke detectors:
1. Sensor: Responsive to both visible and invisible products of combustion. Self-compensating for changes in environmental conditions.
2. Detector sensitivity: Between 0.5 and 1.7 percent/foot (0.0016 and 0.0056 percent/mm) smoke obscuration when tested according to UL 268A.

D. Duct smoke detector: Photoelectric type.

1. Sampling tube: Design and dimensions as recommended by the manufacturer for the specific duct size, air velocity, and installation conditions where applied.
2. Relay fan shutdown: Contacts rated to interrupt fan motor-control circuit.

2.5 CONCEALED DETECTOR INDICATING AND TEST STATION

A. Description: Flush-mounted, single-gang station for each duct smoke detector and other detector that is not readily visible, with indicating light and test switch.

B. Indicating light: Flashes when the associated device is in an alarm or trouble mode.

C. Test switch: Forces detector into alarm, allowing test of outputs programmed to occur following alarm initiation at devices.

D. Device plate: Red plastic with engraved white letters reading SMOKE DETECTOR ABOVE CEILING, or other text as appropriate.

2.6 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and have screw terminals for system connections.


B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns produce a sound-pressure level of 90 dB, measured 10 feet (3 m) from the horn.

C. Visible alarm devices: Synchronized xenon strobe lights listed under UL 1971 with clear or nominal white polycarbonate lens. Mount lens on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on a removable sleeve on the lens.

1. Rated light output: Indicated on drawings for each location.
2. Strobe leads: Factory connected to screw terminals.

D. Speakers:
1. UL 1480 listed.
2. Sound output: Minimum of 84 dBA at 10 feet when tapped at 0.5 watt, and maximum of 87 dBA at 10 feet. Taps shall be available at 0.25, 0.5, 1, and 2 watts.
3. 25 or 70.7 V rms.
4. Mounting: Flush or surface-mountable; bidirectional as indicated, with sealed back.
5. Operation: From standard signaling circuits or addressable single- or multizone I/O modules.

E. Combination speaker/strobe units: Speaker and visible alarm device as specified above, mounted in a fire-retardant, high-impact, white polycarbonate housing suitable for flush or surface mounting.
   1. Speaker: Tapped at 0.5 watts; 25 V rms.

2.7 FIRE ALARM NOTIFICATION BOOSTER

A. Power supply booster designed to extend power available to notification appliance circuits.

B. Enclosure: Steel, with lockable front panel allowing access to all interior components, surface-mounted.

C. Functions: Contains circuits to monitor and charge batteries, control and supervise 4 Class B appliance circuits, and monitor two controlling inputs from external sources.
   1. Configurable to operate at any one of three signaling rates, or to follow the main panel's notification appliance circuit.
   2. Trouble contact with 16-second delay.

D. Batteries: Two, sized for 24 hours of standby followed by 15 minutes of alarm.

E. Indicators: LEDs, one for each circuit, one for battery supervision, one for ground fault, and one for power.

2.8 ADDRESSABLE INTERFACE DEVICE

A. Monitor module: Microelectronic monitor module listed for use in providing a system address for external alarm-initiating devices with normally open contacts.
   1. Dual circuit, intelligent, signaling circuit interface module.

B. Control module: Microelectronic control relay module listed for use in providing control to external appliances or equipment shutdown.
1. One Form C (SPDT) dry relay contact rated at 2 amps and 24 volts DC.

C. Isolator module: Microelectronic fault isolator module listed for isolating and removing a fault from a data circuit while allowing the remaining data loop to continue operating.

1. Protect loop system against wire-to-wire short circuits by isolating section of loop and permitting other loop sections to continue to operate.

D. Non-addressable control relay: Isolation relay for the control of HVAC unit contactors, UL 864 listed.

1. Construction: Sealed, non-removable, with terminations to pressure-type screw terminals.
2. Rating: Use with circuits up to 240 volts AC at 7 amperes inductive.

2.9 WIRE AND WIRING SYSTEM

A. Non-power-limited circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-voltage circuits: No. 16 AWG, minimum.
2. Line-voltage circuits: No. 12 AWG, minimum.

B. Power-limited circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

C. Wiring system: Class B in accordance with NFPA 72.

D. Survivability: Circuits necessary for the operation of notification appliances shall be protected by a 2-hour fire-rated cable, a 2-hour fire-rated cable system, or a 2-hour fire-rated enclosure.

2.10 PERIPHERAL EQUIPMENT

A. Alarm reporting device: A digital communicator shall report an alarm or trouble condition. It shall notify Owner's fire alarm monitoring service and one or more facilities personnel. Provide unit compatible with the Owner's monitoring service.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL
A. Factory-authorized service representative, as required in "Quality Assurance" in Part 1 above, shall supervise installation, software documentation, adjustment, preliminary testing, final testing, and certification of the system, and provide the operating instructions.

B. Provide wiring, conduit, and outlet boxes required for the complete system, in accordance with system manufacturer's instructions and with requirements specified in Division 26 for wiring, conduit, and boxes. Provide 12 inches of slack at each outlet.

1. Install all wiring in conduit.
2. Identification: Paint fire alarm junction box covers red.

C. Wires, cables, conduits, and wiring connections are specified in Division 26, Electrical. Include in the work of this section, wiring, conduits, and equipment connections complying with the requirements of Division 26, so that the fire alarm system will function as specified and indicated on the drawings.

D. Wiring: Free from grounds or crosses between conductors.

1. Identification: Color code wiring, not duplicating building wiring colors. Tag each wire at each junction point.

E. Final connections between equipment and the wiring system shall be made under the direction and supervision of the qualified supplier.

F. Provide 20 percent spare capacity for each notification appliance circuit.

3.2 INSTALLATION, FIRE ALARM NOTIFICATION BOOSTER

A. Provide number of notification power supply boosters required for a complete fire alarm system.

B. Utilize spare single-pole, 20-ampere circuit breaker in a 120-volt electrical panelboard to make electrical connection to each power supply booster.

1. Circuit breakers shall match and shall be compatible with the other breakers in the panelboard.

C. Branch circuits from panelboards to each notification power supply booster: Two No. 12 wires and one No. 12 ground in conduit no less than 0.75 inch (21- mm) trade size.

D. Install conduits and wiring as specified in Sections 26 05 19 and 26 05 33.

E. Provide smoke detector above each power supply booster.
3.3 INTERFACE WITH OTHER WORK

A. Furnish duct smoke detectors to be installed as part of ductwork specified in Division 23.

3.4 LOCATIONS OF FIRE ALARM EQUIPMENT

A. Locate the control panel, annunciator, and other associated equipment as shown on the drawings.

B. Visual indicating appliances: Install where shown on the drawings. If field conditions require variation from drawings, do not violate ADA requirements, including, but not limited to, the following:

1. Any room or space required to have a visual appliance, including corridors or hallways: No place shall be more than 50 feet from the indicating appliance in the horizontal plane.
2. Rooms and spaces exceeding 100 feet in one dimension, without obstructions 6 feet above the finished floor: Indicating appliances may be placed around the perimeter, spaced approximately 100 feet apart.

C. Provide a smoke detector at each fire alarm panel location, including but not limited to main control, auxiliary control, and power panels.

3.5 INSPECTION, TEST, ADJUSTMENT AND REPORT

A. Furnish equipment and appliances for testing the complete system during progress of the work and after completion of the installation, including a megger test of wiring. The tests generally shall demonstrate the following:

1. Circuits are continuous and free from short circuits.
2. Circuits are free from unspecified grounds.
3. Resistance to ground of non-grounded circuits is not less than one megohm.
4. Circuits are properly connected in accordance with the applicable wiring diagrams.
5. Each detector operates correctly.
6. Detectors are correctly located and sufficient in number.

B. Defects or omissions observed during general and system tests shall be repaired as quickly as possible and the tests reconducted.

C. Submit report as required in Part 1 above.

3.6 OPERATING INSTRUCTIONS

A. As specified in Section 26 05 00, provide operating instructions.
B. Provide at least 8 hours of additional instruction time for the systems and equipment specified in this section, consisting of 2 periods of 4 consecutive hours, during a period of not more than 60 days.

END OF SECTION
SECTION 31 10 00 - SITE CLEARING

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. Removing existing trees, shrubs, groundcover, plants, and grass.
   2. Clearing and grubbing.
   3. Stripping and stockpiling topsoil.
   4. Removing above- and below-grade site improvements.
   5. Disconnecting, capping or sealing, and abandoning site utilities in place removing site utilities.
   6. Temporary erosion and sedimentation control measures.

   B. Related Sections include the following:

   1. Division 31 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS
   A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

   B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.
1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS (NOT USED)

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without written permission from the Owner.
   2. Provide alternate routes around closed or obstructed traffic ways.

B. Utility Locator Service: Notify Miss. Utility a minimum of 3 days prior to performing any land disturbing activities. Contact Miss Utility of Delmarva 1-800-282-8555

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS (Not Applicable)

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 Section "Earthwork."
   1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.
C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
   1. Do not store construction materials, debris, or excavated material within fenced area.
   2. Do not permit vehicles, equipment, or foot traffic within fenced area.
   3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
   1. Cover exposed roots with burlap and water regularly.
   2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
   3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
   4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.
   1. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Owner will arrange to shut off indicated utilities when requested by Contractor.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify the Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the Owner's written permission.

C. Excavate for and remove underground utilities indicated to be removed.
D. Removal of underground utilities is included in Division 2 Sections covering site utilities.

3.4 CLEARING AND GRUBBING
A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 24 inches below exposed subgrade.
   4. Use only hand methods for grubbing within tree protection zone.
   5. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING
A. Remove grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Do not stockpile topsoil within tree protection zones.
   2. Dispose of excess topsoil as specified for waste material disposal.
3. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
   1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 31 10 00
This page is intentionally left blank.
SECTION 31 20 00 – EARTHWORK SITE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for pavements, walkways, and pads.
2. Excavating and backfilling for retaining walls and structures.
4. Subbase course for asphalt paving.
5. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:

1. Division 31 Section Site Clearing for, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Division 32 Section Erosion and Sediment Control, for temporary erosion and sediment control.
3. Division 32 Section Lawns and Grasses for finish grading, including preparing and placing topsoil and planting soil for lawns.

1.03 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation, including the backfill of retaining walls, footings and foundations.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill. See section 2.1 for the requirements of borrow soil.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grade.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 SUBMITTALS

A. Comply with Division 1 Section Submittal Procedures.

B. For Approval
   1. Product Data: For the following:
C. For Information:
   1. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
      a. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
      b. Laboratory compaction curve according to ASTM D 698 for each on-site and borrow soil material proposed for fill and backfill.

1.05 PROJECT/ SITE CONDITIONS

A. Test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.

B. Existing Utilities: Locate existing underground utilities by hand excavation in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
   1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner. Do not break utility connections without providing temporary services, as acceptable to Engineer.
   2. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.
      a. Provide, to Architect, a minimum of 48 hour notice to proceed before interrupting any utility.
   3. Demolish and completely remove from site any existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

C. Use of Explosives: The use of explosives is not permitted.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
   1. Operate warning lights as recommended by authorities having jurisdiction.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

1.06 QUALITY ASSURANCE
A. Regulatory Requirements: Comply with applicable regulatory requirements of municipality and utility companies.

B. Under pavements, prepared subgrade must be proof rolled to a visually firm and stable condition and to a minimum of 95 percent maximum dry density as determined by a standard proctor test (ASTM: D698) with a minimum 10-ton smooth-wheeled roller in presence of a qualified Geotechnical Engineer or Technician prior to the placing of any base material.

C. A qualified Geotechnical Engineer or Technician, paid for by the Owner, shall monitor all site preparing, grading, and fill construction. The Engineer/Technician should observe and document the site preparation, existing fill material removal, and fill/backfill construction work, and make appropriate field tests, as necessary, to verify that acceptable fill materials are being used and that construction is being performed in accordance with applicable plans, specifications and acceptable construction practices.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. Note: No warranty is made regarding the amount of on site soils material suitable for use as fill or backfill of any kind.

B. Satisfactory Soils: Satisfactory soils for use as fill are defined below:

1. Structural fill, Fill under building slabs on grade and foundations, drives and parking, and behind retaining walls (where applicable): Where available, on site soil materials may be used where these on site soils conform to the requirements of the Delaware Department of Transportation Type G – Select borrow. Where sufficient on site soils materials are not available, off site borrow conforming to the requirements of the Delaware Department of Transportation Type G – select borrow shall be provided.

2. Fill under walkways: Where available, on site soil materials may be used where these on site soils conform to the requirements of the Delaware Department of Transportation Type C – select borrow. When sufficient on-site soils materials are not available, off site borrow conforming to the requirements of the Delaware Department of Transportation Type C – select borrow shall be provided.

3. Fill under unimproved, grass or landscape areas: Any on site soil material free of organic material and rocks or clumps larger than 2 inches.

C. Backfill:
1. Backfill for all utility trenches under asphalt, walkway areas: may be on site material where these on site soils conform to the requirements of the Delaware Department of Transportation Type C – Select borrow. When sufficient on-site soils materials are not available, off site borrow conforming to the requirements of the Delaware Department of Transportation Type C – select borrow shall be provided.

2. Backfill for all utility trenches under unimproved, grass areas: Any on site soil material free of organic material and rocks or clumps larger than 2 inches.

D. Fill: All fill shall be comprised of satisfactory soil material as defined above, section 2.01.B.

E. Subbase: Shall be Delaware Department of Transportation Type A CR-1 graded aggregate, DelDOT specification section 821.03.

F. Bedding: Shall be Delaware Dept. of Transportation #57 stone.

G. Drainage Fill Course: Shall be Delaware Dept. of Transportation #57 stone.

2.02 GEOTEXTILES

A. Geotextile Filter Fabric: Nonwoven geotextile, specifically manufactured as a drainage and separation geotextile, made from polypropylene staple fibers; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 120 lb; ASTM D 4632
2. Tear Strength: 60 lb; ASTM D 4533
4. Water Flow Rate: 135 gpm per sq. ft.: ASTM D 4491
5. Apparent Opening Size: No. 70: ASTM D 4751

B. Geotextile Support Fabric: Woven geotextiles, specifically manufactured for use as a support and separation geotextiles, comprised of UV stabilized polypropylene slit film; and with the following minimum properties according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 315 lb; ASTM D 4632.
2. Tear Strength: 120 lb; ASTM D 4533.
4. Apparent Opening Size: No. 40; ASTM D 4751.

2.03 GEOGRID REINFORCEMENT

A. For use in unsuitable soil areas, as directed by the Architect, shall be an integrally formed grid structure manufactured of a stress resistant polypropylene material. The geogrid shall accept applied force in use by positive mechanical interlock with
compacted soil or construction fill materials. The geogrid shall possess sufficient flexural stiffness to enable efficient installation over weak or wet in situ soils and shall possess complete continuity of its properties throughout its structure. Geogrid soil reinforcement shall be Tensar BX1100 geogrid, or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing," during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.02 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. The bidder is responsible for complete dewatering for all site work including stormwater management and erosion control facilities. All dewatering methods must be approved by DNREC and must be per the DNREC ESC Handbook, latest revision effective February 2019. The bidder should thoroughly familiarize themselves with existing on-site soils and groundwater conditions and review the Geotechnical Report.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.03 EXPLOSIVES

A. Explosives: Do not use explosives.
3.04 SITE STRIPPING AND PREPARATION IN STRUCTURAL AREAS

A. At the start of construction all existing topsoil, roots, asphalt and existing fill material should be stripped and removed in their entirety from the proposed building, parking, and drive areas extending to a minimum lateral distance of 10’ beyond outer edge of paved areas and 15’ beyond outside edge of building footings. Any existing fill material that may be encountered in previously disturbed areas (e.g., utility trenches), as well as any existing utility lines, should also be removed in their entirety from the building area.

B. After completing removal of the above, and upon reaching grade (in cut areas) and/or subgrade (in fill areas), the entire area should be proof-rolled with a minimum 10-ton smooth-wheeled roller or other approved equipment. The purpose of the proof-rolling is to densify the exposed grade/subgrade areas, which have been loosened or disturbed during the stripping/grading operation. In addition, the proof-rolling will expose any localized soft areas not encountered during the test boring program. In subgrade areas to receive structural fill, the exposed subgrade areas should be compacted to a visually firm and stable condition; compacted subgrade must be inspected and approved by the Geotechnical Engineer. This subgrade compaction effort will enable any structural fill to be placed and compacted at the required densities. Any localized soft and/or excessively wet subgrade areas encountered during this program, which cannot be adequately stabilized by drying and compacting, should be undercut and replaced with properly compacted structural fill (DelDOT Type G) or other suitable materials as directed by Geotechnical Engineer.

3.05 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.06 EXCAVATION FOR RETAINING WALLS AND OTHER STRUCTURES (if applicable)

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.07 EXCAVATION FOR WALKS AND PAVEMENTS
A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.08 EXCAVATION FOR UTILITY TRENCHES
A. Excavate trenches to indicated gradients, lines, depths, and elevations.
B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit.
   1. Clearance: 12 inches each side of pipe or conduit.
C. Trench Bottoms: Excavate trenches deeper than bottom of pipe elevation to allow for bedding course (bedding course thickness and material shall be as specified on the drawings and/or specs and as recommended by manufacturer). Hand excavate for bell of pipe.

3.09 SUBGRADE INSPECTION
A. Notify Architect/Geotechnical Engineer when excavations have reached required subgrade.
B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
C. Proof-roll subgrade below pavements, walkways and structures with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated, or frozen subgrades.
   1. Completely proof-roll subgrade in one direction.
   2. Proof-roll with a minimum 10-ton vibratory roller or a fully loaded tandem dump truck in the presence of a qualified soils technician.
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Geotechnical Engineer, and replace with compacted backfill or fill as directed.
D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, dust/drought conditions, or construction activities, as directed by Geotechnical Engineer.
3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, foundations and retaining walls.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill, material as defined in section 2.01.C to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of material specified in section 2.01.C to final subgrade elevation.

3.13 STRUCTURAL LOAD BEARING FILL/BACKFILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
B. The load bearing fill material should be placed in horizontal thin lifts with a loose thickness no greater than 8 inches. For top 1-foot of pavement subgrade, each thin lift of fill material should be compacted to 98% maximum dry density, as determined by the Standard Proctor Test (ASTM D-698). For fills below 1 foot of pavement subgrade and for structural fill below building slab and footings/footings, each thin lift of fill material should be compacted to 95% maximum dry density, as determined by the Standard Proctor Test (ASTM D-698). Structural fill placement, as defined above, shall extend to a minimum lateral distance of 10’ beyond outer edge of paved areas and 15’ beyond outside edge of building footings.

C. Place soil material on subgrades free of mud, frost, snow, ice, or other deleterious materials.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and fills below 1-foot of pavement subgrade, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. For top 1-foot of pavement subgrade, each thin lift of fill material should be compacted to 98% maximum dry density.
3. Under walkways, scarify and recompact top 6 inches (below subgrade and compact each layer of backfill or fill soil material at 95 percent.
4. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
5. For utility trenches, compact each layer of backfill soil material at 95 percent.
3.16  GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

3.17  SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements, courts, and walks as follows:

1. Where shown on the plans, install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Shape subbase course to required crown elevations and cross-slope grades.
3. Place subbase course 6 inches or less in compacted thickness in a single layer.
4. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
5. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18  FIELD QUALITY CONTROL

A. Testing Agency: Owner shall engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work complies with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of
other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas and Areas beneath athletic courts: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
2. Structural Fill and Backfill: At each compacted backfill layer, at least 1 test for each 2000 square feet, but no fewer than 2 tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 20 00
SECTION 31 23 19 - DEWATERING

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 construction dewatering.

B. Related Sections:
   1. Division 01 Section "Construction Progress Documentation" for recording preexisting conditions and dewatering system progress.
   2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
   3. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
   4. Division 33 Section "Subdrainage" for permanent foundation wall, underfloor, and footing drainage.

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

   1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
   3. Prevent surface water from entering excavations by grading, dikes, or other means.
   4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
   5. Remove dewatering system when no longer required for construction.
1.4 SUBMITTALS

A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.

B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For qualified Installer, land surveyor, and professional engineer.

D. Field quality-control reports.

E. Other Informational Submittals:
   1. Photographs: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to dewatering including, but not limited to, the following:
   a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
   b. Geotechnical report.
   c. Proposed site clearing and excavations.
   d. Existing utilities and subsurface conditions.
1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect no fewer than (2) days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Architect's and Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
2. The geotechnical report is referenced elsewhere in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Monitor dewatering systems continuously.

E. Promptly repair damages to adjacent facilities caused by dewatering.

F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 01 Section "Temporary Facilities and Controls" Division 31 Section "Site Clearing" during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

1. Maintain piezometric water level to the minimum DNREC required depth below surface of excavation.

E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 FIELD QUALITY CONTROL

A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.

3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 31 23 19
SECTION 32 12 16 - ASPHALT PAVING

PART 1  GENERAL

1.01  RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.02  SECTION INCLUDES

A. Refer to Scope Information Sheets for this contract bound in the Project Manual under Section 01010, SUMMARY OF WORK. The Scope Information Sheets describe generally the work included in each contract, but the work is not necessarily limited to that described.

B. Provisions for hot-mixed asphalt paving over prepared subbase.

C. Proof rolling of prepared subbase.

D. Traffic Paint

E. Contractor shall coordinate all construction documents; where conflicts arise between these specifications and the design drawings, the more stringent shall apply. The Contractor is advised to contact Owner with any questions prior to resolving any conflicts, or modifying any of the original design.

1.03  RELATED SECTIONS

A. Prepared subbase is specified in another Division 31, Section “Earthwork Site”.

B. Saw-cutting of edges of existing pavement is specified in site-clearing section.

1.04  SUBMITTALS

A. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

1.05  PROJECT/SITE CONDITIONS

A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 deg F (10 deg C) and when temperature has not been below 35 deg F (1 deg C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.
B. Construct hot-mixed asphalt surface course when atmospheric temperature is above 40 deg F (4 deg C) and when base is dry. Base course may be placed when air temperature is above 30 deg F (minus 1 deg C) and rising.

C. Grade Control: Establish and maintain required lines and elevations.

1.06 MATERIALS

A. General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations.

B. Coarse Aggregate: Sound, angular crushed stone, crushed gravel, or properly cured crushed blast furnace slag, complying with ASTM D 692-88.

C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone, properly cured blast furnace slag, gravel, or combinations thereof, complying with ASTM D 1073.

D. Asphalt Cement: ASTM D 3381 for viscosity-graded material; ASTM D 946 for penetration-graded material.

E. Prime Coat: Cut-back asphalt type, ASTM D 2027; MC-30, MC-70 or MC-250.

F. Tack Coat: Emulsified asphalt; ASTM D 977.

G. Subbase Reinforcement Fabric. Structural Geogrid BX 1200

1.07 ASPHALT-AGGREGATE MIXTURE

A. Provide plant-mixed, hot-laid asphalt-aggregate mixture complying with ASTM D 3515 and applicable Delaware Department of Transportation standards.

1.08 TRAFFIC PAINT

A. Traffic Paint: Apply traffic paint for striping and other markings with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide a 15-mil minimum wet film thickness. All traffic striping is to conform to Delaware Department of Transportation standard specifications.

PART 2 - EXECUTION

2.01 SURFACE PREPARATION

A. General: Remove loose material from compacted subbase surface immediately before applying prime coat.
B. Proof-roll prepared subbase surface to check for unstable areas and areas requiring additional compaction.

C. Notify Engineer of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.

D. Prime Coat: Apply at rate of 0.20 to 0.50 gal. per sq. yd., over compacted subgrade. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

E. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface.

F. Allow to dry until at proper condition to receive paving.

G. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

2.02 PLACING MIX

A. General: Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. Spread mixture at minimum temperature of 225 deg F (107 deg C). Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.

B. Paver Placing: Place in strips not less than 10 feet wide, unless otherwise acceptable to Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete the base course for a section before placing surface course.

C. Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute.

D. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.

2.03 ROLLING

A. General: Begin rolling when mixture will bear roller weight without excessive displacement.

B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.

D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.

E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained 95 percent laboratory density.

F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

2.04 FIELD QUALITY CONTROL

A. General: Test in-place hot-mix asphalt courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Engineer.

B. Thickness: In-place compacted thickness tested in accordance with ASTM D 3549 will not be acceptable if exceeding following allowable variations:

1. Base Course: Plus or minus ½ inch.
2. Surface Course: Plus or minus 1/4 inch.

C. Surface Smoothness: Test finished surface of each hot-mixed asphalt course for smoothness, using 10-foot straightedge applied parallel with and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:

1. Base Course Surface: 1/4 inch.
2. Wearing Course Surface: 3/16 inch.

D. Check surface areas at intervals as directed by Engineer.

END OF SECTION 32 12 16
SECTION 32 22 10 - EROSION AND SEDIMENT CONTROL

PART 1  GENERAL

1.01  RELATED DOCUMENTS
Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 and 2 Specification sections apply to work of this section.


1.2  SUMMARY
A. This Section includes the following:

1. Temporary erosion control devices required during construction.

B. Related Sections include the following:

1. Division 31 Section Site Clearing for site stripping, grubbing, stripping, and stockpiling topsoil and removal of above and below ground improvements.

2. Division 31 Section Earthwork for excavation, grading, fill placement, and backfill of excavations with specified materials.

1.3  DEFINITIONS (NOT USED)

1.4  SUBMITTALS
A. Comply with Division 1 Section Submittal Procedures

B. For Approval:

1. Product Data: For the following:
   a. Filter cloth and pre-fabricated silt fence.
   b. Geotextile fabrics

C. For Information:

1. Materials test report: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
   a. Classification according to ASTM of all stone and aggregate for use in erosion control devices such as stabilized construction entrances, rock check dams, temporary sediment traps.

1.5 QUALITY ASSURANCE
EROSION & SEDIMENT CONTROL

32 22 10 - 1
A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

B. General Intent: In accordance with State of Delaware, Section 1, Title 7, Delaware Code Chapter 40 "Erosion and Sediment Control Act," erosion and sediment control will be minimized during construction of the project by temporary and/or permanent stabilization by seeding and other controls to limit erosion. All erosion and sediment controls shall be constructed and installed as detailed on drawings and as per DNREC’s Delaware Erosion & Sediment Control Handbook, February 2019. As part of the base bid contract scope of work Contractor is responsible for installing additional Erosion & Sediment Control (ESC) measures as directed by Certified Construction Reviewer CCR and/or Engineer as construction progresses. The actual ESC measures shown on the plan are the minimum required to start work and install the proposed site improvements. As construction progresses additional ESC items may be required (i.e. dewatering bag, stone check dams, silt tubes, etc.) to comply with the State Sediment and Stormwater Regulations; these ESC items must be installed as directed by CCR and/or Engineer at no additional cost to owner. Contractor is also responsible for maintaining all ESC measures throughout duration of construction including re-seeding disturbed areas and repairing ESC items as directed by CCR and Engineer.

1.6 PROJECT CONDITIONS (NOT USED)

PART 2 - PRODUCTS

2.1 SILT FENCE (must conform to DNREC ESC Handbook Standards, February 2019):

2.2 STABILIZED CONSTRUCTION ENTRANCE (must conform to DNREC ESC Handbook Standards, February 2019)

A. Stone: Use 2” stone or recycled concrete equivalent

B. Filter Fabric: Woven or non-woven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, and be mildew and rot resistant. Fabric shall be Trevira Spunbond 1135, Mirafi 600X or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALL EROSION CONTROL MEASURES in accordance with the latest issue of Delaware Erosion Control Handbook (effective February 2019) and as shown on drawings. ESC Measures include, but are not limited to the following: stabilized construction en-
trance, silt fence, super silt fence, stone check dams, pumping/dewatering pits, dirt bags, sediment basin, temporary diversion swales, erosion control matting, inlet protection, and temporary stabilization measures.

3.2 SILT FENCE & SUPER SILT FENCE: Install in accordance with the latest issue of Delaware Erosion Control Handbook (effective February 2019) and as shown on drawings. Maximum allowable slope length shall be per Delaware Erosion Control Handbook Standards and specifications for silt fence.

A. Filter cloth to be fastened securely to fence posts with wire ties or staples.

1. Stake size, installation, spacing, and fabric overlap shall conform to the DNREC ESC Handbook details and specifications.

B. Maintenance shall be performed as needed and material removed when “bulges” develop in the silt fence.

3.3 STABILIZED CONSTRUCTION ENTRANCE:

A. Length: As required, but not less than 50 feet.

B. Thickness: Not less than 6 inches.

C. Width: 10 foot minimum, but not less than the full width at points where ingress or egress occurs.

D. Surface Water: All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.

E. Maintenance: The entrance shall be maintained in a condition, which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.

F. Washing: Vehicle wheels shall be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with stone and which drains into an approved sediment-trapping device. See plan for designated tire washing area.

END OF SECTION 32 22 10
SECTİON 33 25 10 - WATER DISTRIBUTİON

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 water-distribution piping and specialties outside the building for the following:

1. Combined water service and fire-service mains.

1.3 DEFINITIONS

A. Combined Water Service and Fire Service Main: Exterior water piping for both domestic-water and fire-suppression piping.

B. Fire-Service Main: Exterior fire-suppression-water piping.

C. Fire-Suppression-Water Piping: Interior fire-suppression-water piping.

D. Water-Distribution Piping: Interior domestic-water piping.

E. Water Service: Exterior domestic-water piping.

F. The following are industry abbreviations for plastic materials:

1. PE: Polyethylene plastic.
2. DIP: Ductile Iron Pipe.

1.4 SUBMITTALS

A. For approval:

1. Pipe and Fittings.
2. Gate Valves and accessories.
3. Tapping Sleeves and Valves.
4. Fire Hydrants.
1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Regulatory Requirements:

1. Comply with requirements of utility company supplying water (City of Wilmington). Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection (City of Wilmington).
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing (City of Wilmington).

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade.
F. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect, City of Wilmington not less than seven days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect and the City of Wilmington’s written permission.

1.8 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: C-900, with mechanical-joint, bell- and plain-spigot end.
1. Mechanical-Joint, Ductile-Iron Fittings: C-900, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Glands, Gaskets, and Bolts: C-900, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: Class 52, with push-on-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
   1. Push-on-Joint, Ductile-Iron Fittings: Class 52, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
      a. Gaskets: Class 52, rubber.

2.4 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
   1. Manufacturers:
      c. Mueller Co.; Water Products Div.
      d. McWane, Inc.; Clow Valve Co. Div.
      e. McWane, Inc.; Kennedy Valve Div.
      f. McWane, Inc.; Tyler Pipe; Utilities Div.
      g. NIBCO, INC.
      h. United States Pipe and Foundry Company.

   2. Non-rising Stem Gate Valves 3 Inches (80 mm) and Larger: AWWA C509, resilient seated; bronze stem, iron body and bonnet with epoxy coated interior surfaces, iron disc with epoxy coating and replaceable steel reinforced rubber seat, double O-Ring seal stuffing box, 2" operating nut, open left, 200-psig (1380 kPa) working pressure, mechanical joint ends. Mueller A-2370-20, open left or approved equal.

   3. Valve Boxes: Cast-iron box having top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches (124 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve. Mueller Type H10360, or approved equal.

   4. Provide one steel tee-handle operating wrench. Wrench shall have tee handle with one pointed end, stem of length to operate deepest valve, and socket-fitting valve-operating nut.
2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies: Comply with MSS SP-60. Include sleeve and valve compatible with drilling machine.

1. Manufacturers:
   b. Mueller Co.; Water Products Div.
   c. International Piping Services Company.
   d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   e. McWane, Inc.; Kennedy Valve Div.
   f. McWane, Inc.; M & H Valve Company Div.
   g. United States Pipe and Foundry Company.

2. Tapping Sleeve: Tapping sleeves shall be a Mueller mechanical joint tapping sleeve model H-615, or approved equal. The sleeve shall be a 2 piece bolted sleeve with flanged outlet for new branch connection. The outlet flange dimensions and drilling shall comply with ANSI B16.1, class 125. Sleeve shall be iron body with 3/4" 1/PT test plug and shall have a maximum working pressure of 200 psig.

3. Tapping Valve: Tapping valves shall be a Mueller Double Disc tapping valve model H-667, or approved equal. The valve shall meet or exceed all applicable requirements of ANSI/AWWA C500 standards. The inlet flange shall comply with ANSI B16.1, class 125 drilling, the mechanical joint outlet shall comply with ANSI/AWWA C111 Standards. The valve shall have a bronze mounted iron body, be non-rising stem and have an O-ring sealed stuffing box. The disk assembly shall be a double disc parallel seat with four point wedging mechanism. A 2" square wrench nut shall be provided. The valve shall open left.

2.6 FREESTANDING FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants: Shall comply with ANSI/AWWA C502, shall be dry top design with O-ring sealed oil reservoir. Hydrant shall have a compression type main valve that closes with pressure, shall have a 5-1/4” main valve opening three way (two hose nozzles and one pumper nozzle), shall have a 200 psig maximum working pressure and a 400 psig maximum test pressure, the hydrant shall be Mueller Super Centurion A-423 or approved equal (must comply with City of Wilmington standards).

1. Manufacturers:
d. American Foundry Group, Inc.
e. Mueller Co.; Water Products Div.
f. McWane, Inc.; Clow Valve Co. Div.
g. McWane, Inc.; Kennedy Valve Div.
h. United States Pipe and Foundry Company.

PART 3 - EXECUTION

3.1 EARTHWORK
   A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS
   A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

   B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

   C. Do not use flanges, unions, or keyed couplings for underground piping.

   D. Flanges, unions, keyed couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

   E. Underground Water-Service Piping: Use the following piping materials for each size range:

3.3 JOINT CONSTRUCTION
   A. See Division 2 Section "Utility Materials" for basic piping joint construction.

   B. Make pipe joints according to the following:


3.4 PIPING SYSTEMS - COMMON REQUIREMENTS
   A. See Division 2 Section "Utility Materials" for piping-system common requirements.

3.5 PIPING INSTALLATION
   A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections to City of Wilmington water mains with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Install ductile-iron piping according to AWWA C600 and AWWA M41.
   1. Bury piping with depth of cover over top at least 30 inches.

E. Install piping by tunneling, jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

3.6 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:


B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

3.8 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. AWWA-Type Fire Hydrants: Comply with AWWA M17.

3.9 CONNECTIONS

A. Piping installation requirements are specified in other Division 2 Sections. Drawings indicate general arrangement of piping and specialties.
B. See Division 2 Section "Utility Materials" for piping connections to valves and equipment.

C. Connect water-distribution piping to City of Wilmington water main. Use tapping sleeve and tapping valve.

3.10 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.

   1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour, decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.11 CLEANING

A. Clean and disinfect water-distribution piping as follows:

   1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
   2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:

      a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
      b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
      c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
      d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

C. After completing drinking fountain installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
D. Clean drinking fountains, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 33 25 10
This page is intentionally left blank.
SECTION 32 31 10 – DECORATIVE CANTILEVER GATE SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Repair and installation of existing decorative cantilever gate. Contractor shall provide all labor, materials and appurtenances necessary for repair and installation of the welded decorative steel gate system as shown on drawings.

B. Contractor shall:
   1. Furnish & install new posts for decorative cantilever gate with new required latching and mounting hardware.
   2. Refurbish & install decorative cantilever gate and new required operational, mounting, and latching hardware.
   3. Furnish & install new 12 gauge barbed wire as shown on drawings. Match Zoo’s spacing and mounting standards.
   4. Repaint any exposed or rusted metal with approved paint system.

1.2 RELATED DOCUMENTS

A. Division 02 “Earthwork”.

B. Division 03 “Cast in Place Concrete”.

1.3 QUALITY ASSURANCES

A. Only Contractors whose experience and workmanship that have been previously reviewed and pre-qualified by the Architect for the Work of this Section. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.4 REFERENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.


E. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.


I. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.5 FIELD MEASUREMENTS

A. Prior to installation, the contractor shall verify that all field measurements are as indicated on Drawings and Schedules, and notify the Architect in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.

1.6 SUBMITTALS

A. Product Data: Provide product data on padlocks, sprockets, ball-screw assemblies, finish paint systems, and other pertinent items.

B. Samples: Submit one 24” x 24” sample of fencing type and size specified.

1.7 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.8 PRODUCT WARRANTY
A. All new structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. All industrial ornamental cantilever gates shall conform to the Ameristar® TransPort II® gate system, Classic™ design, manufactured by Ameristar Perimeter Security USA Inc., in Tulsa, Oklahoma. The system shall include all components (i.e., tracks, uprights, bracing, pickets, hardware, fittings, and fasteners). See project gate schedule for additional information.

2.2 MATERIAL

A. The materials used for cantilever gate framing (uprights & diagonal bracing) shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish. The TransPort™ enclosed tracks shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with a yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish.

B. Material for pickets shall be 1” square x 1/8” wall aluminum pickets on gate systems greater than 24’ openings, gate systems less than 24’ openings shall have 1” square x 16 ga. steel pickets. Picket on center spacing shall not exceed 5”. Pickets shall be securely fastened to face of top and bottom enclosed track extrusions.

C. Material for gate uprights and diagonal bracing shall be 2” square x ¼” wall aluminum. The cross-sectional shape of the enclosed-track shall confirm to the manufacturers Fast-Trak™ design with as a single extrusion consisting of a 2” x 5” channeled support with integrated 2” x 2” enclosed-track raceway. Gates less than 24’ openings shall be constructed as a single track system, gates greater than 24’ openings shall be constructed as a dual track system.

D. Steel material for fence posts and pickets shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength...
of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90. Material for gate support posts shall be 4” square x 11 Ga. tubing.

E. Suspension Rollers for enclosed tracks shall be used at each support post to track connection. Each truck assembly shall be capable of being adjusted vertically via threaded rod for fine-tune adjustment. Truck assembly shall be constructed in a way so that the primary housing for the truck rollers shall pivot via ball-bearing connection to threaded rod.

2.3 GATE REPAIR AND REPAINTING

A. Gate frame uprights and diagonal bracing shall be pre-fabricated and pre-punched to accept frame fasteners. Enclosed track shall be pre-punched to accept gate uprights. Pickets shall be precut to specified length and predrilled to accept picket to track fasteners. Posts shall be precut to specified lengths.

B. Top and bottom enclosed track extrusions shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Diagonal bracing shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Pickets shall be mechanically fastened to top and bottom enclosed track, as required by assembly instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that field conditions are acceptable and are ready to receive work. Do not install until any unsatisfactory conditions are corrected. Beginning Work constitutes contractor's acceptance of conditions as satisfactory. All new installation shall be laid out by the contractor in accordance with the construction plans.

B. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.

C. Clean and strip site primed steel items to bare metal where site welding is scheduled.

D. Make provision for erection loads with temporary bracing. Keep work in alignment.
E. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate trades.

3.2 COORDINATION

A. Coordinate all material requirements with other pertinent specification Sections relevant to the Work of this Section.

3.3 GATE INSTALLATION

A. Cantilever support posts shall be set in concrete footers having a minimum depth of 48” (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The “Earthwork” and “Concrete” sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

B. Gate to be installed per manufacturer’s gate installation instructions. Gate shall be installed in compliance with ASTM F2200 standards.

C. Gate posts shall be spaced according to the manufacturers’ gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers’ gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer’s recommendations

3.4 GATE RE-PAINTING

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures’ warranty.

B. Repaint any exposed or rusting metal on existing panels. See 3.4.A.
3.5 CLEANING

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

<table>
<thead>
<tr>
<th>Quality Characteristics</th>
<th>ASTM Test Method</th>
<th>Performance Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesion</td>
<td>D3359 – Method B</td>
<td>Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).</td>
</tr>
<tr>
<td>Corrosion Resistance</td>
<td>B117, D714 &amp; D1654</td>
<td>Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8&quot; coating loss from scribe or medium #8 blisters).</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>D2794</td>
<td>Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).</td>
</tr>
<tr>
<td>Weathering Resistance</td>
<td>D822, D2244, D523 (60° Method)</td>
<td>Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 32 31 13 – CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. PVC-coated steel chain-link fabric.
   2. Polymer-coated steel framework.

1.2 SUBMITTALS
A. Product Data: For each product indicated.
B. Shop Drawings: Show locations, components, materials, dimensions, sizes, weights, finishes of components, installation and operational clearances, gate swings, and details of post anchorage and attachment and bracing.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC
A. Steel Chain-Link Fence Fabric: Comply with Chain Link Fence Manufacturers Institute's "Product Manual."
   1. Mesh and Wire Size: 2-inch mesh, 0.120-inch diameter
B. Fabric Selvage: Knuckled at both selvages

2.2 FENCE & GATE FRAMING
A. PVC Coated, Round Posts and Rail: ASTM F 761.
   1. Fence Height: as shown on drawings
   2. Line, End, Corner, and Pull Posts and Top Rail: As required for Light-Duty fence.
   3. Gate Posts, Gates, and Accessories: Comply with ASTM F 654, gate type as indicated, made from Polymer-coated steel metal pipe and tubing for individual gate widths as shown on Drawings with complete with hardware.

2.3 TENSION WIRE AND FITTINGS
A. Metallic-Coated Steel Tension Wire: 0.177-inch diameter, marcelled tension wire complying with ASTM A 824 at locations indicated.
B. Fittings: Provide fittings for a complete fence installation, including special fittings for corners. Comply with ASTM F 626.
2.4 CAST-IN-PLACE CONCRETE

A. General: Comply with ACI 301 for cast-in-place concrete; materials consisting of portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water.

1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

2.5 POLYMER FINISHES

A. Supplemental Color Coating: In addition to specified metallic coatings for steel, provide fence components with polymer coating.

B. Metallic-Coated Steel Tension Wire: PVC-coated wire complying with ASTM F 1664, Class 1.

C. Metallic-Coated Steel Framing: Comply with ASTM F 1043 for polymer coating applied to exterior surfaces and, except for tubular shapes, to exposed interior surfaces.

D. Miscellaneous Components: Comply with ASTM F 626 for the following:

1. Fittings.
2. Post and line caps. Cone shape.
3. Rail and brace ends.
4. Top rail sleeves.
5. Tension and brace bands.
6. Tension bars.
7. Truss rod assemblies.
8. Padlocks will be provided by Owner.
9. Door Pulls on both sides of gate.
10. Slide Bolts & Staples - one bolt per gate
11. Cane Bolts - one per gate
12. Padlocks Tabs - one per gate.
13. Tie wires, clips, and fasteners.

E. Color: To match chain-link fabric - Black complying with ASTM F 934.
PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil.

1. Concrete Footings: Place concrete around posts and vibrate or tamp for consolidation. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured. Set the following post types in concrete footings and protect portion of posts aboveground from concrete splatter:

a. Terminal.

b. Line; Using mechanical devices to set line posts per ASTM F 567 is [not] permitted.

c. Gate.

D. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 70 feet.

E. Line Posts: Space line posts uniformly at 10 feet o.c.

F. Top Rails: Install in one piece as indicated spanning between posts, using fittings, special offset fittings, and accessories.


H. Tie Wires: Attach wire to chain-link fabric per ASTM F 626. Tie fabric to line posts at maximum interval of 12 inches o.c. and to braces at maximum interval of 24 inches o.c.

I. Barbwire: Install per Zoo’s spacing and mounting standards.

J. Support rails: Attach per detail.

END OF SECTION
(THIS PAGE INTENTIONALLY LEFT BLANK)
SECTION 32 31 19 – DECORATIVE FENCES AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Repair and installation of all decorative fencing and gates. Contractor shall provide all labor, materials and appurtenances necessary for furnishing, repair and installation of the welded decorative steel fence system as shown on drawings.

B. Contractor to:
   1. Furnish & install new posts for decorative fence panels with required panel mounting hardware.
   2. Furnish & install new decorative single service gate & posts with required mounting and latching hardware.
   3. Remove, refurbish & install existing decorative fence panels with required panel mounting hardware.
   4. Furnish & install new 12 gauge barbed wire as shown on drawings. Match Zoo’s spacing and mounting standards.
   5. Repaint any exposed or rusted metal with approved paint system.

1.2 RELATED DOCUMENTS

A. Division 02 “Earthwork”.

B. Division 03 “Cast in Place Concrete”.

1.3 QUALITY ASSURANCES

A. Only Contractors whose experience and workmanship that have been previously reviewed and pre-qualified by the Architect for the Work of this Section. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.4 REFERENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.


E. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.


1.5 FIELD MEASUREMENTS

A. Prior to installation, the contractor shall verify that all field measurements are as indicated on Drawings and Schedules, and notify the Architect in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.

1.6 SUBMITTALS

A. Product Data: Provide product data on padlocks, sprockets, ball-screw assemblies, finish paint systems, and other pertinent items.

B. Samples: Submit one 24" x 24" sample of fencing type and size specified.

1.7 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.8 PRODUCT WARRANTY

A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The fence system shall conform to Montage II® Welded and Rackable (ATF – All Terrain Flexibility) Ornamental Steel, Classic™ design, with extended picket bottom rail treatment, 4-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma. The system shall include all components (i.e., panels, posts, gates and hardware) required.

2.2 MATERIAL

A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.

B. Material for pickets shall be 1” square x 14 Ga. tubing. The rails shall be steel channel, 1.75” x 1.75” x .105”. Picket holes in the rail shall be spaced 4.715” o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.3 FABRICATION (IF NEEDED)

A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar’s proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be (specify Black or Bronze). The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Swing gates shall be fabricated using 1.75” x 14ga Forerunner double channel rail, 2” sq. x 12ga. gate ends, and 1” sq. x 14ga. pickets. Gates that exceed 6’ in width will have a 1.75” sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6’.

F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48” width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5” x 6” footprint). Hinge-closer set shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5” - 1.375”) and vertical (0 -.5”). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

2.4 GATE HARDWARE AND KEYING

A. Refer to schedules and details on drawings.

B. Substitutions: All substitutions for the hardware of this Section must be reviewed and approved by the Architect and Owner prior to Bid acceptance.

C. Keying – coordinate all keying with the Project General Contractor and the requirements of Division 08 Section “Door Hardware”, in the Specifications for the overall Project.

D. Padlocks:
   1. Padlocks will be provided by Owner.

E. Door Pulls
   1. Provide on both sides of gate.

F. Slide Bolts & Staples:
   1. Provide one bolt per gate
G. Cane Bolts:
   I. Provide one per gate

H. Padlocks Tabs:
   I. Provide one per gate.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that field conditions are acceptable and are ready to receive work. Do not install until any unsatisfactory conditions are corrected. Beginning Work constitutes contractor's acceptance of conditions as satisfactory. All new installation shall be laid out by the contractor in accordance with the construction plans.

B. Obtain Architect/Engineer's approval prior to site cutting or making adjustments not scheduled.

C. Clean and strip site primed steel items to bare metal where site welding is scheduled.

D. Make provision for erection loads with temporary bracing. Keep work in alignment.

E. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate trades.

3.2 COORDINATION

A. Coordinate all material requirements with other pertinent specification Sections relevant to the Work of this Section.

3.3 FENCE INSTALLATION

A. Fence post shall be spaced according to Table 3, plus or minus ½”. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36” (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The “Earthwork” and “Concrete” sections of this specification shall govern material requirements for the concrete footer. Posts
setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.4 FENCE PAINTING

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufacturers’ warranty.

B. Repaint any exposed or rusting metal on existing panels. See 3.4.A.

3.5 GATE INSTALLATION

A. Gate posts shall be spaced according to the manufacturers’ gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers’ gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer’s recommendations.

3.6 CLEANING

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.
### Table 1 – Minimum Sizes for Montage II Posts

<table>
<thead>
<tr>
<th>Fence Posts</th>
<th>Panel Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1/2” x 12 Ga.</td>
<td>Up to &amp; Including 6’ Height</td>
</tr>
<tr>
<td>3” x 12 Ga.</td>
<td>Over 6’ Up to &amp; Including 8’ Height</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gate Leaf</th>
<th>Gate Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 4’</td>
<td>2-1/2” x 12 Ga.</td>
</tr>
<tr>
<td>4’1” to 6’</td>
<td>3” x 12 Ga.</td>
</tr>
<tr>
<td>6’1” to 8’</td>
<td>3” x 12 Ga.</td>
</tr>
<tr>
<td>8’1” to 10’</td>
<td>4” x 11 Ga.</td>
</tr>
<tr>
<td>10’1” to 12’</td>
<td>4” x 11 Ga.</td>
</tr>
<tr>
<td>12’1” to 14’</td>
<td>4” x 11 Ga.</td>
</tr>
<tr>
<td>14’1” to 16’</td>
<td>6” x 3/16”</td>
</tr>
</tbody>
</table>

### Table 2 – Coating Performance Requirements

<table>
<thead>
<tr>
<th>Quality Characteristics</th>
<th>ASTM Test/Method</th>
<th>Performance Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesion</td>
<td>D3359  – Method B</td>
<td>Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).</td>
</tr>
<tr>
<td>Corrosion Resistance</td>
<td>B117, D714 &amp; D1654</td>
<td>Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8” coating loss from scribe or medium #8 blisters).</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>D2794</td>
<td>Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).</td>
</tr>
<tr>
<td>Weathering Resistance</td>
<td>D822 D2244, D523 (60° Method)</td>
<td>Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).</td>
</tr>
</tbody>
</table>

### Table 3 – Montage II – Post Spacing By Bracket Type

<table>
<thead>
<tr>
<th>Span</th>
<th>For INVINCIBLE® 8’ Nominal (91-1/2” Rail)</th>
<th>For CLASSIC, GENESIS, &amp; MAJESTIC 8’ Nominal (92-5/8” Rail)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Size</td>
<td>2-1/2”</td>
<td>3”</td>
</tr>
<tr>
<td>Bracket Type</td>
<td>Industrial Flat Mount (BB301)*</td>
<td>Industrial Line 2-1/2” (BB319) 3” (BB320)</td>
</tr>
</tbody>
</table>

DECORATIVE FENCES & GATES 32 31 19 - 7
**DECORATIVE FENCES & GATES**

<table>
<thead>
<tr>
<th>Post Settings ± ½” O.C.</th>
<th>94-1/2”</th>
<th>95”</th>
<th>94-1/2”</th>
<th>95”</th>
<th>96”</th>
<th>96-1/2”</th>
<th>96”</th>
<th>96-1/2”</th>
<th>*96”</th>
<th>*96-1/2”</th>
</tr>
</thead>
</table>

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.

**END OF SECTION**
SECTION 32 91 13  TOPSOILING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Prepare subsoil.
   2. Furnish and place topsoil for turf areas and planting beds.
B. Related Sections:
   1. Section 32 91 15 – Amended Planting Soil
   2. Section 32 92 00 – Lawn Turf and Grasses
   3. Section 32 93 00 – Planting

1.3 STANDARDS
A. The quality of materials and performance of work specified in this section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, January, 1998.
   1. Section 733: Topsoiling

1.4 SUBMITTALS
A. Legal Documents
   1. Submit a complete materials list of items to be provided under this section for approval by the Owner’s Representative before the purchase of any material.
   2. Submit a list of proposed methods of execution of work under this section for approval by the Owner’s Representative when proposed methods are different from or supplementary to those specified herein.
   3. Submit copies of soil test recommendations called for in this section.
B. Delivery Slips
   1. Submit delivery slip for all shipments of topsoil showing the product volume and name of supplier.

1.5 PRODUCT DELIVERY AND STORAGE
A. Obtain all legal rights or easements necessary from private owners on whose lands
topsoil may be stored. Furnish rights or easements in written form and signed by both CONTRACTOR and property OWNER involved, or their duly authorized representatives.

B. Fertilizer and lime shall be delivered and stored in original unopened packages, kept dry, and not opened until needed for use. Damaged or faulty packages shall not be used.

1.6 JOB CONDITIONS

A. Existing Conditions

1. Perform topsoiling only after preceding work affecting ground surface is completed.

B. Environmental Requirements

1. Topsoil shall not be moved or spread in frozen or muddy condition.

C. Protection

1. Protect trees and shrubs to remain as part of final landscaping against damage.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Existing Topsoil - Topsoil may be reused from site excavation with approval from Owner’s Representative. See Section 32 91 15- Amended Planting Soil.

B. Imported Topsoil - Where additional topsoil is not available or insufficient, topsoil may be imported. Representative samples will be made available by the contractor for testing.

C. Imported topsoil shall be Enriched Horticultural Topsoil by Laurel Valley Soils or approved equal meeting the following requirements:

1. Natural loam topsoil free from subsoil, obtained from an area that has never been stripped. It shall be of uniform quality, free from hard clods, stiff clay, sods, stone, lime, cement, ashes, slag, or other undesirable material.

2. Organic matter shall fall in the range of 5 – 10%, determined by loss of ignition of moisture-free samples dried in accordance with the current method of the Association of Official Agricultural Chemists. The acidity range shall be pH 5.0 to 7.0 inclusive. Maximum soluble salts: 500 ppm. The mechanical analysis of the soil shall be as follows:
3. The Contractor shall furnish certified report(s) of the testing laboratory showing the analysis of a representative sample of the topsoil. A separate report shall be furnished for each source of topsoil. The Contractor shall furnish the reports to the Owner’s Representative before any topsoil is delivered to the site.

4. The Owner’s Representative reserves the right to reject topsoil in which more than 60 percent of the material passing the No. 100 U.S.S. Mesh Sieve consists of clay as determine by the Bouyoucous hydrometer or by the Decantation method. All percentages are to be based on dry weight of sample. If the Owner’s Representative directs, topsoil which varies only slightly from the Specifications may be acceptable by such corrections, as the Owner’s Representative deems necessary.

5. All topsoil shall have a range of pH from 5.5 to pH 6.2.

6. Topsoil shall contain no more than 10% organic matter as determined in accordance with the AASHTO T 267 test method. The following nutrients shall fall within the ranges listed:
   - Soluble salts shall not exceed 300 ppm/0.9 mmhos/cm.
   - Cation Exchange Capacity (CEC) 8 or greater.
   - Carbon/Nitrogen Ratio less than 20:1.
   - The following elements shall not exceed the indicated amount:
     - Iron 3ppm
     - Boron 0.5 ppm
     - Manganese 2ppm
     - Potassium 200ppm
Sodium 40ppm  
Copper 0.4 ppm  
Zinc 1.5 ppm  
Molybdenum 0.15ppm  
Magnesium – Mg 25-100ppm  
Phosphorus – P 5-30ppm  
Potassium – K 50-200ppm  
Calcium – Ca 75-300ppm

7. Toxic elements and compounds shall be below a maximum level as recommended by the approved soil testing facility for the plants being grown.

8. Acceptable mechanical ranges for topsoil:  
   Sand 45-65%  
   Silt 20-35%  
   Clay 10-20% Pore space, 35 – 50 percent.  
   Permeability shall not be less than 1” per hour.  
   If sand is used, an angular quartz sand such as NJ#3 from US Silica is required.

2.2 SOIL AMENDMENTS PER SOIL TEST RECOMMENDATIONS
   A. Dolomite Lime: Shall be agricultural grade mineral soil conditioner containing 35% minimum magnesium carbonate and 49% minimum calcium carbonate, 100% passing No. 65 sieve, Kaiser Dolomite 65 AG or approved equal.

2.3 PLANTING BED SOIL MIX
   A. See Section 32 91 15 - AMENDED PLANTING SOIL.

PART 3 - EXECUTION

3.1 SITE PREPARATION
   A. Do not proceed with topsoiling until conditions are satisfactory.
   
   B. Verify that clearing, earthwork, grading and other preceding work affecting ground surface have been completed and approved by landscape architect or Owner’s Representative.
       1. Final subgrade elevation and contours shall be smooth and uniform to
required lines and elevations. All variations, lumps, ridges, and depressions in subgrade shall be corrected before topsoil work is started. Remove all stones, clods, lumps two inches or larger in any dimension; remove all wires, cables, pieces of concrete, tree roots, and debris or other unsuitable material.

2. Do not move heavy objects over the proposed subgrade planting areas.

C. At the discretion of the Owner's Representative, obtain analysis from an accredited soils lab at the Contractor's cost.

D. The subsoil shall be loosened to a depth of no less than 6", or as directed by the Owner's Representative.

3.2 SOIL TESTING

A. Complete soil test for all topsoil to be reused from project site.

B. Soil samples shall be submitted to a testing facility capable of all testing required under these specifications and approved by Landscape Architect.

C. The soil test should determine mechanical analysis, soluble salt level, N,P,K, levels, pH, organic matter content, cation exchange, and micro-nutrient levels, bulk density. For off-site sources of topsoil, proctor analysis and chemical residue contamination screening are required.

D. Submit soil test results from an approved soil testing laboratory from a representative sample of the proposed imported topsoil to landscape architect for approval a minimum of 30 days in advance of plans to transport it to the site.

E. Submit a physical sample of 1 gal. soil for each soil type/mix to be provided. This is in addition to submittals to analytical labs, made by contractor.

F. Contractor shall submit to landscape architect for approval source of topsoil (if natural to be obtained from within 75 miles of project site) or if manufactured soil submit name and location of manufacturer.

3.3 COORDINATION

A. Placement of soil media shall:

1. NOT be performed when sub-grade surfaces are porous, wet, frozen or spongy.

2. Be placed to maintain optimum moisture content of backfill materials to attain required compaction density.

3. Employ a placement method that does not disturb or damage other work, existing conditions, or surrounding soils.

B. Before placing or depositing soil media upon any area as shown on the plans, the sub-
base shall be approved by landscape architect.

1. Subsoil shall be loosened to a depth of 6” by mechanical means.
2. Add remainder of soil media to depths specified.

3.4 SUBGRADE PREPARATION

A. 1. Scarify subgrade by tilling planting beds to a uniform depth of not less than four inches (4") and not more than six inches (6") prior to placement of topsoil unless directed otherwise by the Landscape Architect. Remove all vegetation, debris, unsuitable soil materials, obstructions, and deleterious materials from scarified soil. Legally dispose of all debris off Owner’s property.

2. Plow, strip, or break-up sloped surfaces steeper than one (1) vertical to four (4) horizontal to a depth of not less than six inches (6") so that fill material will bond with existing surface.

3. When existing ground surface has a density less than that specified under "Compaction," for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

3.5 MOISTURE CONTROL

A. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material.

1. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight. Prevent free water appearing on surface during or subsequent to compaction operations.

2. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3. Puddling or jetting shall not be permitted.

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
3.6 PLACING TOPSOIL & PLANTING SOILS

A. Plan sequence of work to minimize compaction of soil and ensure that no heavy equipment will run across finished surfaces. Sequence of work must ensure a uniform profile and prevent localized compaction. (For example, work performed to back machines out of areas where work occurs.) Soil media shall be spread on these areas to a depth sufficiently greater than that specified on the plans. After natural settlement has taken place, the work must be in close conformity to acceptable compaction tolerances and finish grade or meet surrounding edge conditions.

B. Topsoil or Amended Planting Soil shall be installed and incorporated in six inch lifts to the following total depths, or as indicated on the drawings:
   1. 6 inch minimum for turf areas;
   2. 24 inch minimum for other planting areas, including planting beds and specimen trees wells.
   3. Each lift shall be compacted to specified percent that will generally not exceed 85% - evenly through the profile. The final elevation of the soil media shall be based on a specified compaction rate and shall correspond to elevations shown on the plans.

C. Final soil grades in flat areas will result in slight crowning of the soil, while grades on other areas will be with the intent of guiding runoff to drainage

D. Remove stones, lumps, roots and other objects larger than one inch in any dimension from graded topsoil surface.

3.7 DEWATERING

See Division 31 Section “Earthwork” for dewatering measures

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile satisfactory salvaged surface soil materials as well as imported topsoil, compost, soil amendments, etc. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
   2. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
   3. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil mix.
   4. Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine
texture. Rake, remove ridges, and fill depressions to meet finish grades.

B. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.9 UTILITY TRENCH BACKFILL
A. After utility trench has been backfilled satisfactorily to subgrade, fill trench to finished grade with topsoil. To the following depths:
   1. Under proposed lawn areas: min. 6 inches of topsoil
   2. Under proposed plant beds: min. 12 inches of topsoil.

3.10 COMPACTION OF BACKFILLS AND FILLS
A. See Division 31 Section Earthwork for specifications regarding backfill and fill.
B. For the upper level of subgrades under lawn and plant bed areas, compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with ASTM D-1557; and not less than the following percentages of relative density determined in accordance with ASTM D-2049, for soils which will not exhibit a well-defined moisture-density relationship.
   1. Lawn or Unpaved Areas: Compact top six inches (6") of subgrade and each layer of backfill or fill material at 90 percent (90%) maximum dry density.
   2. Trench Stabilization Materials: Compact each layer of material to 95 percent (95%) of maximum dry density.

3.11 FINE GRADING
A. General: Uniformly grade topsoiled areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

3.12 PROTECTION
A. When required, erect temporary signs and barriers to protect topsoiled area.

3.13 MAINTENANCE
A. Immediately before establishment of planting material, re-topsoil and re-grade areas which become eroded, settled or otherwise disturbed.
B. Perform all maintenance work in accordance with the Specifications without additional compensation.
C. Maintenance period to extend until installation of planting material.

3.14 CLEANING
A. Immediately clean spills, soil, and conditioners on paved and finished areas.
B. Haul and dispose of topsoil in excess of the quantity required for the project off site.
C. Dispose of protective barricades and warning signs at termination of maintenance period.

END OF SECTION
SECTION 32 91 15 - AMENDED PLANTING SOIL

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Amending of existing soil to prepare for installation of planting beds, turf, & specimen trees.

B. Related Sections:
   1. Section 32 91 13 – Topsoiling
   2. Section 32 92 00 – Turf and Grasses
   3. Section 32 93 00 – Planting
   4. Section 31 – Subsurface Drainage

1.3 STANDARDS

A. The quality of materials and performance of work specified in this section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, January, 1998.
   1. Section 733: Topsoiling

1.4 SUBMITTALS

A. Legal Documents
   2. Submit a complete materials list of items to be provided under this section for approval by the Owner’s Representative before the purchase of any material.
   3. Submit a list of proposed methods of execution of work under this section for approval by the Owner’s Representative when proposed methods are different from or supplementary to those specified herein.
   4. Submit copies of soil test recommendations called for in this section.

B. Delivery Slips
   1. Submit delivery slip for all shipments showing the product volume and name of supplier.

1.5 PRODUCT DELIVERY AND STORAGE

A. Obtain all legal rights or easements necessary from private owners on whose lands topsoil may be stored. Furnish rights or easements in written form and signed by both CONTRACTOR and property OWNER involved, or their duly authorized representatives.
1.6 JOB CONDITIONS

A. Existing Conditions
   1. Perform work in this scope only after preceding work affecting ground surface is completed.
   2. Verify locations of all underground utilities prior to start of work.

B. Environmental Requirements
   1. Topsoil shall not be moved or spread in frozen or muddy condition.

C. Protection
   1. Protect trees and shrubs to remain as part of final landscaping against damage.

PART 2 - PRODUCTS

2.1 COMPOST

A. Compost shall be certified by US Composting Council as STA Organic Compost. Laboratory results of submittal sample shall satisfy the following:
   - Soluble Salts no greater than 10 mmhos/cm
   - % solids content 50-60% (50-40% moisture)
   - Organic matter 30-60%
   - Nitrogen 0.5-2.5 % (dry weight basis)
   - pH 5.0 to 8.0
   - Total Carbon up to 55% by weight
   - C:N Ration less than 20% dry weight basis
   - Pass select pathogens and Trace Metals
   - Bio Assay >95%

2.2 SOIL AMENDMENTS TO ALTER pH AS PER SOIL TEST RECOMMENDATIONS

A. Dolomite Lime: Shall be agricultural grade mineral soil conditioner containing 35% minimum magnesium carbonate and 49% minimum calcium carbonate, 100% passing No. 65 sieve, Kaiser Dolomite 65 AG or approved equal.

2.3 TOPSOIL

A. If, after completion of soil amendments, soil volume is insufficient to meet finish grades then topsoil may be imported to job site. See Section 32 91 13- TOPSOILING.
2.4 PLANTING BED SOIL MIX
   A. Planter Soil Mix: Mix topsoil with the following soil amendments and fertilizers in the following quantities:
      
      Ratio of Loose Compost to Topsoil by Volume: 1:3 parts
      
      Weight of Slow-Release Fertilizer per 1000 Sq. Ft.: 1 to 2 pounds of water-insoluble nitrogen with a NPK ratio of either 3-1-2 or 3-1-1, unless otherwise indicated by soil tests.

2.5 LAWN SOIL MIX
   A. Lawn Soil Mix: Mix topsoil with the following soil amendments and fertilizers in the following quantities:
      
      Ratio of Loose Compost to Topsoil by Volume: 1:3 parts, Friable clay loam soil with pH between 5 and 7.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Do not amend or place any soil or soil amendments until conditions are satisfactory. No work shall be performed when existing conditions are porous, wet, frozen or spongy.
   
   B. Verify that clearing, earthwork, grading and other preceding work affecting ground surface have been completed and approved by Landscape Architect or Owner’s Representative.

3.2 SOIL TESTING
   A. Complete soil test through approved soil testing laboratory from a representative sample of all existing soil to remain on project site in planting beds or turf areas. The soil test should determine mechanical analysis, soluble salt level, N,P,K, levels, pH, organic matter content, cation exchange, micro-nutrient levels, and bulk density. Submit soil test results for approval by Landscape Architect.
   
   B. Submit lab test results from an approved soil testing laboratory from a representative sample of the proposed imported compost to Landscape Architect for approval a minimum of 30 days in advance of plans to transport it to the site.
   
   C. Submit source of compost (name and location) to Landscape Architect for approval.
   
   D. Submit a physical sample of 1 gal. compost to be provided. This is in addition to
submittals to analytical labs made by contractor.

3.3 COORDINATION
A. Coordinate work to maintain optimum moisture content of materials and existing soil to attain required compaction density.
   1. Employ a placement method that does not disturb or damage other work, existing conditions, or surrounding soils.
   2. Do not move or set heavy objects over proposed planting areas at any time during project sequence.

3.4 INSTALLATION FOR PLANTING BEDS & LAWN AREAS
A. Plan sequence of work to minimize compaction of soil and ensure that no heavy equipment will run across finished surface. Sequence of work must ensure a uniform profile and prevent localized compaction. (For example, work performed to back machines out of areas where work occurs.) Soil media shall be spread on these areas to a depth sufficiently greater than that specified on the plans. After natural settlement has taken place, the work must be in close conformity to acceptable compaction tolerances and finish grade or meet surrounding edge conditions.
B. Final soil grades in flat areas will result in slight crowning of the soil, while grades on other areas will be with the intent of guiding runoff to drainage
C. Remove stones, lumps, roots and other objects larger than one inch in any dimension from graded surface.

3.5 DEWATERING
A. See Section “Earth Moving” for dewatering measures

3.6 STORAGE OF MATERIALS
A. Stockpile materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust or importation of weed seed.
   1. Stockpile materials away from edge of excavations. Do not store within drip line of remaining trees.

3.7 AMENDING SOIL FOR PLANTING BED & LAWN AREAS
A. Remove existing soil material in planting beds & planters to a minimum depth of 18 inches. Loosen existing soil in turf areas to a depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
B. Grade planting beds to a smooth, uniform surface with loose, uniformly fine texture.
Rake, remove ridges, and fill depressions to meet finish grades.

C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.8 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place compost on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.9 COMPACTION

A. See Section Earth Moving for specifications regarding backfill and fill.
B. Compact planting areas to 90 percent (90%) maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with ASTM D-1557.

3.10 FINE GRADING

A. General: Uniformly grade planting areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
   3. Slope grades to direct water away from buildings and to prevent ponding.

3.11 PROTECTION

A. When required, erect temporary signs and barriers to protect work area.

3.12 MAINTENANCE

A. Immediately before establishment of planting material, regrade areas which become eroded, settled or otherwise disturbed.
B. Perform all maintenance work in accordance with the Specifications without additional compensation.
C. Maintenance period to extend until installation of planting material.
3.13 CLEANING
   A. Immediately clean spills, soil, and conditioners on paved and finished areas.
   B. Haul and dispose of materials in excess of the quantity required for the project off site.
   C. Dispose of protective barricades and warning signs at termination of maintenance period.

END OF SECTION
SECTION 32 92 00 – LAWN TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. This section defines standards for turf installation or restoration from start of project through final acceptance. Included are standards for sod specifications, handling, installation and maintenance until project completion.
   2. Sodding disturbed lawn areas as shown on drawings.
   3. Lawn renovations
   4. Bank Seeding

B. Related Sections:
   1. Division 32 Section - Topsoiling
   2. Division 32 Section – Planting

1.2 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submit, upon request, documentation prior to the start of work under this Section that all related materials have been ordered.

C. Certification of Grass Sod: From sod vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of cutting.
D. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.

E. Sod: Submit, upon request, an invoice or sales slip identifying quality and species present in sod.

F. Qualification Data: For landscape Installer.

G. Timing of sod installation is to be coordinated with General Contractor prior to delivery of materials to site.

H. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns until acceptance of substantial completion.

I. Soil Analysis: Upon request, obtain analysis of soil from an accredited soil laboratory, at the cost of the Landscape Contractor, to determine suitability of topsoil for lawn growth. Provide pH and recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil to support turf.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed landscape work similar in material, design, and extent to that indicated for turf work and with a record of successful turf establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced English speaking full-time supervisor on Project site when planting is in progress.

2. Installer is to maintain an experienced full-time supervisor on the Project site during all times throughout execution of this portion of the Work, who is thoroughly familiar with proper materials and methods for successful turf installation, to direct all work performed under this Section. This person shall have a minimum of 5 years’ experience in successful turf establishment.

B. Topsoil Analysis: See Division 32 Section “Topsoil” for requirements regarding topsoil testing and analysis. Additionally, for topsoil intended for lawn areas:

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

D. Codes and Standards: Preform all work in compliance with applicable requirements of governing authorities having jurisdiction.
E. Sodding:

1. All materials are subject to approval by Owner’s Representative, who may inspect materials either at place of growth or at site before installation, for compliance with specified species and materials.

2. All seed and sod are to be provided as specified. Requests to use substitutions shall be made prior to delivery of materials to site.

3. In the event that quantity discrepancies or material omissions occur between the Plant List and Planting Plan, Contractor is to immediately notify Owner’s Representative for clarification about how to proceed.

F. Equipment:

1. Provide machinery and equipment necessary for the prompt, professional completion of the work. Such machinery shall be adequate to the task required and shall be operated by a person skilled and experienced in both operation of the equipment and the implementation of the task.

2. Upon request, promptly furnish satisfactory evidence of the organization, operator and equipment to be made available for the performance of the work.

1.5 DELIVERY, STORAGE, AND HANDLING OF EQUIPMENT

A. Sod handling shall comply with State and Federal laws, including quarantines with respect to inspection, plant diseases and insect infestation.

1. Sod shall be relatively free of thatch.

2. Sod shall be free of diseases, nematodes and soil-borne insects

1.6 SCHEDULING

A. Permanent lawn plantings are ideally installed during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Final Acceptance of lawn areas:

1. Spring Planting: April 1-May 31 – or once soil temperatures reach a minimum of 50 degrees Fahrenheit.

2. Fall Planting: August 15 – October 15

B. Proceed with installation only when existing and forecasted weather conditions permit. If projected or current weather will undermine turf installation, reschedule installation times and dates.
1. In the event that a project needs to stabilize a site during winter months or times when sod/seed needs to be installed outside of optimum planting times, site should be stabilized according to DNREC regulations, with the contractor returning at the next optimal planting time to properly install and establish the lawn area as per requirements for Final Acceptance.

1.7 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: 60 days from date of Final Acceptance.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water lawn at a minimum rate of 1 inch (25 mm) per week.

D. Mow lawn as soon as top growth exceeds 3”. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule subsequent mowings to maintain the following grass height:

1. Mow grass 2 to 3 inches (50 to 75 mm) high.

E. Lawn Post-fertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.
PART 2 - PRODUCTS

2.1 IMPORTED PLANTING SOIL
   A. Shall be composed of 2/3 parts topsoil and 1/3 part organic matter. See Amended Planting Soil Specification.
   B. Shall be natural friable clay loam soil with a pH between 5 and 7 (soil analysis to be performed to determine necessary amendments) and shall contain not less than 6% and not more than 10% organic matter.
   C. Shall be without subsoil, refuse, or any foreign material.

2.3 COMPOST
   A. Preferred compost is Laurel Valley Compost. Substitutions should be the same quality and content as specified by Laurel Valley’s Compost Analysis.
      1. Laurel Valley Soils: 705 Penn Green Rd, Landenberg, PA 19350-9204

2.4 SOIL AMENDMENTS (FOR EXISTING LAWN AREAS ONLY)
   A. Soil amendments and fertilizers are to be purchased and installed as per soil analysis recommendations and rates.
   B. Compost added to existing soil is to be added at a 2" depth per 6" soil, and turned/mixed to a depth of 4 - 6" for turf areas. Final compost: soil ratio should not exceed 10% organic matter in final mixture of soil. Final mixture should meet the specifications set forth for Imported Planting Soil.

2.5 PLANTING ACCESSORIES
   A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.
   B. Erosion control matting: DNREC approved product in areas shown on plans

2.6 LAWN SEED MIX – see drawings for seed mix information

2.7 BANK SEEDING – see drawings for seed mix information

2.8 FERTILIZER
   C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

PART 3 - EXECUTION

3.1 TURF BED PREPARATION

A. Limit disturbance in areas under tree canopies and on slopes.

B. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

C. Disturbed areas and areas stripped of topsoil:

1. Verify that sub-grades and finish grades are accurately established before spreading planting soil.

2. Apply compost and fertilizer directly to surface before loosening.

3. Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

4. For Lay Down and Hall Use Area Restoration:

   1. Follow steps 1-3, but thoroughly loosen all compacted areas to a depth of 12 18" instead of 6", thoroughly mix soil amendments into top 6" of loosened soil.

   2. Spread planting soil mix to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

   3. Reduce elevation of planting soil to allow for soil thickness of sod.

D. Undisturbed Areas:

If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:

1. All stumps, weeds, vegetation not being retained are to be grubbed out and/or removed. After grass or vegetation has been removed. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 4 inches. Apply soil amendments and fertilizers (as needed) according to planting soil mix proportions and mix thoroughly into top 4 inches of soil.

3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.

E. Legally dispose of waste material, including grass, vegetation, and turf, off Owner’s property.

F. Finish Grading/Raking:
   1. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Eliminate rough, low or soft areas. Limit fine grading to areas that can be planted in the immediate future.
   2. Grade or rake planting soil smooth to eliminate rough, low or soft areas, and to insure positive drainage. Slope grades to direct water away from buildings and to prevent ponding.

3.2 LAYOUT

A. Layout specifications and area and perimeter measurements are provided as guidelines only, and are to be confirmed in the field by Contractor(s) and adjusted as necessary and collaboratively with Owner’s Representative.

B. The location of new turf areas are to be reviewed by Owner’s Representative prior to installation.

3.3 SEEDING

A. Seed Application
   1. Apply seed at a rate specified by the specific seed mix evenly in two intersecting directions.
   2. Seed application can be applied using one of the following methods after final soil preparation has been completed and accepted. Seed may be applied in one of two methods:
      a. Hydroseeding by spraying an aqueous mixture on a prepared seedbed.
         1) Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
         2) Mix slurry with nonasphaltic tackifier.
3) Do not use wet seed or seed that is moldy or otherwise damaged.

4) Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at a minimum rate of 500-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb/acre.

5) Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh and 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

b. Dry Application

1) Seed installation either with culti-packer seeder or drop-type/broadcast spreader.

2) Apply in two directions into the top ¼” of soil.

3) Rake in lightly.

4) Roll seeded area with roller not exceeding 50 lbs.

5) Immediately following seeding and compacting, apply mulch.

3.5 FERTILIZERS

A. Apply a starter fertilizer evenly at the rate of 1 c.y./1000 sq. ft. or otherwise as required by the results of the soil tests into the top 2 inches of soil by cross disking or the other appropriate method.

3.6 LAWN RENOVATION

B. Renovate any existing lawn damaged during construction or by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish lawn where settlement or washouts occur or where minor regrading is required.

C. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury in soil. Remove thatch as necessary.

D. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

E. Mow, dethatch, core aerate, and rake existing lawn. Mow turf at lowest setting without scalping the turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Topdress with ½” of approved organic material

I. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top 6 inches of existing soil. Provide new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch or sod as required for new lawns.

K. Water newly planted areas and keep moist until new lawn is established.

L. Overseeding shall be completed in September with a seed mix and application rate approved by Owner’s Representative.

M. Overseeding operations shall be performed with a vertiSeeder.

3.7 WATERING

A. Water newly seeded areas immediately after installation, and thereafter to keep newly seeded areas moist until Final Acceptance.

B. Over watering and pooling should be avoided in seeded area.

3.8 PROTECTION, CLEAN-UP AND MAINTENANCE

A. During turf installation or renovation, keep pavements clean and work area in an orderly condition. Place 3/4” plywood as needed to protect existing turf, paved areas, etc. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Install plastic safety fencing as needed to provide barrier protection for newly planted areas or areas to be preserved. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Protect existing plantings and turf from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damage to new or existing plantings or turf at the expense of the Landscape Contractor.

1. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner’s property.

2. Maintain until condition is approved by Owner’s Representative. All turf areas which fail to germinate or, for sod, fail to knit and actively produce vegetative
root growth within 2 weeks of installation shall be replaced at Contractors expense.

3. Remove erosion-control measures and barricades after grass establishment period.

3.9 SATISFACTORY LAWNS

A. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

END OF SECTION
SECTION 32 93 00 – PLANTING

PART 1 – GENERAL

1.1 SUMMARY

A. This section defines standards for plant selection, handling, installation and care from the project’s start through substantial completion, guarantee period and final acceptance at end of the guarantee period.

B. Section Includes:
   1. Furnish all labor, materials, equipment, and supplies and perform all operations required to complete landscaping work as shown on the drawings and hereinafter specified.
   2. Excavation of tree pits and planting beds to the required depth. Backfill & disposal of all excavated materials as required.
   3. Furnishing and planting of all plants, including woody and herbaceous plants.
   4. Installing, watering, staking, guying, and pruning (if directed) all plants until acceptance by Owner.
   5. Furnishing and placing of mulch.
   6. Maintaining all installed plantings, including watering, until acceptance of the completed work under this Section.
   7. Guaranteeing and replacing of sickly, dying and dead plants through a period of Two (2) year following acceptance of the completed work under this Section.
   8. Protecting all existing site features from damage during the work of this Section.
   9. Maintaining a clean work site throughout duration of planting operations. Clean up of site and removal of any debris at completion of work of this Section.

C. Related Sections:
   1. Section 32 91 13 - Topsoiling
   2. Section 32 91 15 - Amended Planting Soil
   3. Section 32 92 00 – Lawn Turf and Grasses

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by
ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

C. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for kind and size of exterior plant required.

D. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

E. Finish Grade: Elevation of finished surface of planting soil.

F. Planting Soil: See Section 32 91 15 – Amended Planting Soil

G. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

H. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   2. Plant Photographs: Submit color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:
   1. Trees and Shrubs: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison. Where not feasible, Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality.
2. Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

3. Staking and components.

1.4 INFORMATIONAL SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Materials Lists: Within 45 days after award of the Contract, submit a complete list of all materials proposed to be furnished and installed (including sources) under this Section, demonstrating conformance with the requirements specified.

C. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
   1. Manufacturer’s certified analysis for standard products.
   2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
   3. Label data substantiating that plants, trees, and planting materials comply with specified requirements.

D. Qualification data for firms and persons to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Owner’s representatives and owners, and other information specified.

E. Submit project schedule for approval by Owner’s representative at least five days prior to planned start of work. Schedule must include milestone dates that are coordinated with other site trades and locations of work.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.

C. Installer’s Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during all times. Provide at least one English speaking person present at all times during execution of this portion of the work, who is thoroughly
familiar with the type of plants being installed and the proper materials and methods for their installation, to direct all work performed under this Section. This person shall have a minimum of 5 years experience in handling the specified plants, and should have a set of prints of the project on site.

D. Provide quality, size, genus, species, and variety of plants indicated on the Plans, in accordance with the applicable requirements of ANSI Z60.1 American Standard for Nursery Stock, revised 2014. The highest horticultural standards shall be practiced from the time of plant purchase though delivery and installation on site to ensure health, vigor and establishment of all plants.

E. Measurements: Measure trees according to ANSI Z60.1, revised 2014. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Take caliper measurements 6 inches (150 mm) above ground for trees up to a 4-inch (100-mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.

2. Other Plants: Measure with stems and foliage in their normal position.

F. All plants are subject to approval by Owners Representative (OR) who may inspect plants either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. Owners Representative retains the right to further inspect plants for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work and during contract period. Contractor shall remove rejected plants from project immediately and replace with approved replacement, at no cost to Owner.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site. For woody plants and trees: Label at least one (1) plant of each variety and size with a securely attached, waterproof tag bearing legible designation of botanical and common name.

G. All plants are to be provided as specified. Requests to use plant substitutes, whether for size or species/cultivar, shall be submitted in writing to the Owner’s representative for client review and approval, prior to delivery to the job site.

H. Nomenclature and interpretation of plant names shall reference the following. Where the names of plant descriptions disagree, the most current information will prevail:

1. The Royal Horticultural Society Horticultural Database (http://www.rhs.org.uk/).

2. USDA – The Germplasm Resources Information Network:


6. Manual of Woody Landscape Plants; Michael Dirr; Stipes Publishing,
Champaign, Illinois; Most Current Edition.

I. Plants of a larger size may be used if acceptable to Owner’s Representative with a proportionate increase in size of roots or balls, and at no additions to the Contract Price

J. All plants shall comply with State and Federal laws, including quarantines with respect to inspection, plant diseases and insect infestation

K. Collected plants may be used only when approved by the Owner’s Representative.

L. Equipment:
   1. Provide machinery and equipment necessary for the prompt, professional completion of the work. Such machinery and equipment shall be adequate to the task required and shall be operated by a person skilled and experienced in both operation of the equipment and the implementation of the task.
   2. Upon request, promptly furnish satisfactory evidence of the organization and equipment to be made available for the performance of the work.
   3. Comply with all Federal and State Department of Agriculture regulations for pest control which, in general, require that contractors operating in infested areas thoroughly clean all equipment units before moving them to non-infested areas. Full information can be obtained from Federal and State Pest Control Personnel.

M. Documentation and Coordination:
   1. Submit, upon request, documentation prior to the start of work under this Section that all plants and related materials have been ordered.
   2. Plant delivery to site and timing of installation is to be coordinated with Owner’s Representative prior to delivery of plants to site.
   3. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns. If lawns are already established, protect with ¾” plywood, to be removed in manner that ensures viability of existing lawn.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

B. Trees: Deliver freshly dug trees. Do not prune before delivery, except as approved by Owner’s Representative. Protect bark, branches, and root systems from sun scald, desiccation and drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy natural shape. Provide protective covering during delivery to prevent wind burn.

C. Handle balled and burlapped stock by the root ball only; do not stand on or tamp directly on root balls.
D. Container Plants: Deliver all plants to site in containers that ensure the protection of entire plant including roots and other plant parts against climatic and other injuries. Plants shall be grown or established in containers in which they will be delivered for at least 8 months but not for more than 24 months in advance of final planting. Plants shall be fully rooted into container but not root-bound. Plants with cracked or broken balls of earth when taken from the containers shall not be planted unless acceptable to the Owner’s Representative. Do not lift or handle container plants by tops, stems, or trunks at any time.

E. Deliver trees and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist. Properly protect plants with soil, moist mulch, etc.,
1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material, if not installed within six hours from delivery.
2. Root balls/plants shall not be permitted to remain un-installed or exposed during periods of freezing weather or extreme weather conditions.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of trees stored on site as often and thoroughly as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS
A. Utilities: Determine location of above grade and underground utilities and perform work in a manner that will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned. The Contractor shall be responsible for the location and protection of all utilities and for repair of any utilities damaged by Contractor’s work. Any damage shall be replaced/repaired to Owner's satisfaction at the Contractor's expense.
B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Owner’s representative before planting.
C. Work notification: Notify Owner’s Representative at least five (5) working days prior to the start of work of this Section.

1.8 COORDINATION AND SCHEDULING
A. Planting times shall be during one of the following periods. Coordinate planting periods with maintenance periods, as applicable, to provide required maintenance through date of final acceptance.
Spring Planting: April 26 – June 15 (frost-hardy and acclimatized plant material may be planted prior to April 26 and when not restricted by inclement weather limitations).
1. Fall Planting: September 1 – October 15 (plant material may be planted after October 15 and when not restricted by inclement weather limitations).

2. Summer Planting: to be performed on a project by project basis when not restricted by extreme heat and drought conditions, and when a water source and watering equipment are provided and are easily accessible.

3. Dig trees according to the best recommended time, as per fall and/or spring dig hazards. Coordinate planting periods with maintenance periods to provide required maintenance thru date of Substantial Completion.

B. Proceed with planting only when existing and forecasted weather conditions permit. If projected or current weather will stress plants, reschedule planting/installation times and dates

1.9 PLANT MATERIAL QUANTITIES

A. In the event that quantity discrepancies or material omissions occur between the Plant List and Planting Plan, Contractor is to immediately notify Owner’s Representative for clarification and to receive instruction about how to proceed.

1.10 MAINTENANCE

A. Maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Revise duration of maintenance period below to suit Project. Revise starting date of maintenance period to date of planting completion if preferred.

B. Maintenance Period: Until date of Final Acceptance, as confirmed in writing by the Owner.

1.11 SOIL ANALYSIS

A. Soil Analysis: Upon request, obtain analysis of soil from an accredited soil laboratory at the cost of the Landscape Contractor or Project to determine pH and necessary amendments and fertilizers.

1.12 SUBSTANTIAL COMPLETION AND START OF GUARANTEE PERIOD

A. Upon written notice from the Contractor, the Owner’s Representative shall review the work and make a determination if the work is substantially complete.

B. The date of Substantial Completion of the planting shall be the date when the Owner’s Representative accepts that all work in Planting is complete.

C. All plants must be in a vigorous growing condition at the time of Substantial
Completion.

D. The Plant Guarantee period begins at the date of written notification of Substantial Completion from the Owner’s Representative. The date of Substantial Completion for planting may be different than the date of substantial completion for the other sections of the project.

1.14 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Warrant the following living planting materials for a period of two (2) years after the date of Acceptance of Installation, against defects including death and unsatisfactory growth, except for defects resulting from neglect or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor’s control.

1. Trees and Shrubs
2. Herbaceous and groundcover plants

C. Replace at the direction of the Owner’s Representative and in accordance with the Drawings and Specifications, all plants that are dead (all material that is at least 25% dead, and any tree with a main leader that has died back), plants that are in unhealthy or unsightly condition, plants that have lost their natural shape due to dead branches, or other causes due to the Contractor’s negligence.

D. All replacements shall be plants of the same kind, size, and quality as originally specified.

E. Warranty shall not include damage or loss of plants caused by fires, floods, freezing rains, lightning, winds over 75 miles per hour, winter kill caused by severe winter conditions not typical of the planting area, by acts of vandalism, or by negligence on the part of the Owner.

F. Replaced plants shall be furnished, planted, mulched, and watered as part of the warranty.

PART 2 – PRODUCTS

2.1 GENERAL

A. All plants shall be the kind and size indicated on the plant list and shall be true to name. All plants shall be sound, healthy, vigorous, nursery stock with a normal habit of growth, shall be subjected to nursery root and top spraying, transplanting, etc., and shall have
been inspected and approved for sale, transporting and transplanting by all governmental agencies authorized to administer such control. Plants shall be subject to inspection and approval by the Owner’s Representative at place of growth and upon delivery to project site for conformity to specifications. Such approval shall not impair the right of inspection and rejection during process of the work. All trees will be tagged in the nursery by the Owner’s Representative.

B. All plants shall be subject to inspection and approval by the Owner's Representative throughout Contract period. All plants are subject to approval by Owner’s Representative. The Contractor must submit to the Owner's Representative a letter of certification from the supplying nurseries that plants supplied to the contractor conform to the requirements listed below:

1. Provide trees of sizes and grades conforming to ANSI Z60.1 for type of trees required. Trees of a larger size may be used if acceptable to Owner’s representative with a proportionate increase in size of roots or balls, and at no additions to the Contract Price.

C. Prior to delivery to the site, the Contractor shall arrange with the Owner’s Representative a minimum of two nursery visits for the purpose of selecting and tagging plants proposed for the project. This will include all trees as specified. The Owner’s Representative shall inspect proposed plants before plants will be permitted on site.

D. Label at least one (1) tree of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

E. Trees with multiple leaders, unless specified, will be rejected

2.2 SHADE AND FLOWERING TREES

A. Shade trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, free of branches to about 50% of their height, of height and caliper indicated, conforming to ANSI A300 Section 6 for type of trees required.

B. Provide balled and burlapped trees except where indicated.

1. Container-grown trees will be accepted in lieu of balled and burlapped trees subject to meeting ANSI A300 Section 6 limitations for container stock.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according ANSI A300 Section 6 for type, shape, and height of shrub.

2.4 CONIFEROUS EVERGREENS
A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI A300 Section 6.

B. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens:
   1. Provide balled and burlapped trees.

2.5 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI A300 Section 6.

   1. Provide balled and burlapped or container plants as per plant schedule.

2.6 GROUNDCOVER PLANTS

A. Groundcover: Provide groundcover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.7 HERBACEOUS PLANTS

A. Annuals: Provide healthy, disease-free plants of species and variety shown or listed. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

B. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed.

C. Vines: Provide vines of species indicated complying with requirements in ANSI Z60.1 as follows:
   1. Two-year or older plants with heavy, well-branched tops, with not less than 3 runners 18 inches or more in length, and with a vigorous well-developed root system.
   2. Provide field-grown vines. Vines grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable.

2.8 REQUIREMENTS FOR BALLED AND BURLAPPED STOCK

A. Where indicated to be balled and burlapped, provide trees dug with firm, natural ball of earth in which they are grown free of noxious weed matter.

B. Provide ball size of not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree required. Increase ball size or modify ratio of depth to diameter as required to encompass fibrous and feeding root system necessary for full recovery of trees subject to unusual or non-typical conditions of growth, soil conditions or horticultural practice.
C. No balled and burlapped plant will be accepted if the ball is cracked or broken either before or during the process of planting. Root balls shall be firmly wrapped with burlap and bound with natural twine or wire mesh.

D. Wrap and tie earth ball as recommended by ANSI Z60.1 for size of balls required. Drum-lace balls with a diameter of 30" or greater.

2.9 CONTAINER STOCK

A. Container stock shall be grown in its delivery container for not less than six (6) months but not more than 2 years.

B. Plants shall have well established root systems but not be root-bound.

C. Plants with cracked or broken balls of earth when taken from the containers shall not be planted.

2.10 BARE-ROOT STOCK

A. Bare-root stock should have a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for kind and size typical of its species.

B. Plants should be sufficiently packaged and stored to preserve moisture in fibrous root systems to ensure the health and vigor of the plant.

2.11 MULCHES

A. Mulch is to be 100% natural, free from deleterious materials, and suitable as a top dressing for plants.

B. Double shredded hardwood bark mulch.

C. Substitutions may be used only with prior approval from Owner’s Representative.

2.12 LANDSCAPE HAND EDGING

A. Planting beds and tree rings are to be vertically edged with a hand spade or mechanical edger to a minimum depth of 4”. The elevation of the planting bed starts at the low point of the cut edge and angles back towards the planting at a 45 degree angle until it reaches the finish grade of the planting bed. Work excess soil back into planting bed.

2.13 TOPSOIL

A. See Section 32 91 13 - Topsoiling

2.14 SOIL AMENDMENTS:

PLANTING 32 93 00 - 11
A. Fertilizer: “dryROOTS2” root growth enhancer and soil conditioner or approved equal. Apply to soil surface at manufacturer’s recommended rates after planting.

2.15 ANTI-TRANSPIRANT:
A. Shall be "Wilt-Pruf" by Nursery Specialty Products, Inc., 207 East 47th Street, New York, NY 10017, or approved equal, applied as specified by the manufacturer to species as indicated in drawings.

2.16 PLANTING SOIL
A. See Section 32 91 15 – Amended Planting Soil

2.17 EROSION-CONTROL MATERIALS
B. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
C. Erosion-Control Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

2.18 WATERING EQUIPMENT
A. Watering Equipment – to be provided on a project-by-project basis, and to remain the property of the Owner at the completion of the project:
   1. Gator Bags
   2. Ooze Tubes sufficient for watering multi-stem trees or shrubs.
   3. Soaker Hose -should be black or dark color which could blend with mulch, and that can be used above or below soil/mulch surface, will not burst if frozen and provides even distribution of water throughout the planting bed. Installed as per manufacturer’s specifications and as directed by project.

2.19 STAKES AND GUYS FOR TREES
A. Stakes, anchors, and wires shall be of sufficient strength to maintain the tree in an upright position in the conditions in which the tree will be installed.
B. Guy wires shall be galvanized, multi-strand, twisted wire.
C. At the location where guy wires are attached around the tree, the trunk shall be protected with 20-mm (3/4 in.) diameter rubber hose, black or dark green in color, and of sufficient length to extend past the trunk by more than 105 mm (6 in).

PART 3 – EXECUTION

3.1 EXAMINATION
A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
B. Verify that planters have been waterproofed and inspected.
C. Verify the required drainage and irrigation rough-in has been installed and is fully operational.
D. Verify that subgrades are accurately established before spreading planting soil.
E. Once bed preparation has been approved, the Landscape Contractor assumes responsibility for subgrades and finish grades in the areas affected.

3.2 PLANT PRUNING
A. Prune, thin, and shape trees according to standard horticultural practice and as directed by owner’s representative. Prune trees to retain required height and spread. Unless otherwise directed by Owner’s Representative, do not cut tree leaders; remove only crossing, injured or dead branches.

3.3 PLANTING BED PREPARATION
A. Loosen subgrade of planting beds, as needed, to promote adequate drainage and soil conditions promoting plant health and root establishment, but which prevents settlement below finished grade of topsoil layers or plantings. Remove all trash from subgrade along with stones and extraneous debris larger than 1” or that will prevent proper installation and establishment of plantings.
B. All stumps, weeds, vegetation not being retained are to be grubbed out and/or removed.
C. Install planting soil mix in 6” lifts, gently compacted using hand tamping, to a depth that meets finished grades after natural settlement but which ensures root and plant establishment. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet. Do not over compact planting soil; compaction is subject to review and alteration.
   1. Thoroughly blend any soil amendments or fertilizer needed, as per soil test results, into planting soil either before installation of soil lifts, or as lifts are being installed and before tamping. Delay mixing fertilizer with planting soil if planting
will not occur within a few days.

D. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture, ensuring soil surface is free from debris. Rake, remove ridges, and fill depressions to meet finished grades.

E. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

F. Minimize soil disturbance in areas under existing tree canopy or on sloped areas.

G. Planting beds and tree rings are to be vertically edged with a hand spade or mechanical edger to a minimum depth of 4”. The elevation of the planting bed starts at the low point of the cut edge and angles back towards the planting at a 45 degree angle until it reaches the finish grade of the planting bed. Work excess soil back into planting bed.

3.4 PLANTING PIT PREPARATION FOR TREES

A. Verify that subgrades are accurately established before digging tree pit.

B. Dig a hole so that depth will enable tree to be installed in a manner that allows the root flare to be at or slightly above Finished Grade after normal compaction, and at the same relationship to finished grade as they were to the ground from which they were dug.

1. C. Planting hole should be 2–3x wider than the size of the root ball.

3.5 DELIVERY, STORAGE AND HANDLING

A. Plants must be sufficiently containerized, packaged, tarped, etc. to ensure viability of plants and the protection of roots and other plant parts against sun scald, drying, sweating, whipping, and other handling damage as well as climatic seasonal and other injuries.

B. Trees: Deliver freshly dug trees. Do not prune before delivery, except as approved by Owner’s Representative. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy natural shape. Provide protective covering during delivery to prevent wind burn. Do not drop trees during delivery.

C. Water all trees and plants as needed from time of pick up through substantial completion.

D. Do not lift or handle container plants by tops, stems or trunks at any time.

E. Handle balled and burlapped stock by the root ball only; do not stand on or tamp directly on root balls.

F. Deliver trees and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist. Properly protect plants with soil, moist mulch, etc., in a manner acceptable to Owner’s
Representative.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material, if not installed within six hours from delivery.

2. Root balls/plants shall not be permitted to remain un-installed or exposed during periods of freezing weather or extreme weather conditions.

3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of trees stored on site as often and thoroughly as necessary to maintain root systems in a moist condition.

3.6 LAYOUT

A. Layout specifications and area and perimeter measurements are provided as guidelines only, and are to be confirmed in the field by Contractor(s) and adjusted as necessary and collaboratively with Owner’s Representative.

B. The location of new plants and new planting beds are to be staked out in collaboration with and approved by the Owner’s Representative prior to installation.

3.7 PLANT INSTALLATION

A. All root balls removed from containers will be scarified and roots thoroughly separated prior to planting.

B. All plastic or no-rot burlap or twine are to be completely removed from the plant ball prior to backfilling with planting soil. Biodegradable burlap and twine and wire cage material shall be cut away from the top 1/3 of the root ball and remove from the site.

C. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, stop work and notify Owner’s Representative for additional direction.

D. Set plant plumb and in center of planting pit or trench with top of ball raised just above adjacent finish grade enough to allow for normal compaction and sufficient final planting depth, and so surface of root system will be flush with adjacent finished grades after normal settling.

E. Maintain full depth of planting soil around root system of plants.

F. Place soil around ball in layers, tamping gently to settle backfill and eliminate voids and air pockets - do not over tamp. When pit is approximately half backfilled, water thoroughly before placing remainder of backfill

3.8 MULCH INSTALLATION

A. Install mulch on top of raked and prepared planting bed to a depth of 2”, see details.
B. Mulch is to be raked smooth, eliminating pockets and low points.
C. Mulch is not to be applied so that it touches the bark of woody plants or tree trunks.
D. For tree rings: At the time of planting, provide 3 inches high continuous soil saucer around perimeter of planting hole. Prior to end of guarantee period, but not sooner than 8 months after planting, contractor is required to shave off the saucer around the mulch ring area and top dress with new mulch. Cover root ball with no more than 1” (depth) of mulch, installed so that mulch does not touch the bark/trunk.

3.9 STAKING AND GUYING – TREES:
A. Guy and stake trees more than 2.5 -3-inch (75-mm) caliper unless otherwise indicated, or in situations such as sandy or poor soils, in windy locations, or on slopes. Trees that settle out of plumb due to inadequate soil compaction, either under or adjacent to the root ball shall be excavated and reset. Trees that have settled out of plumb shall never be pulled straight using guy wires.

3.10 PROTECTION, CLEAN-UP AND MAINTENANCE
A. During landscape installation, keep pavements clean and work area in an orderly condition. Place 3/4" plywood as needed to protect existing turf, paved areas, etc.
B. Install plastic safety fencing as needed to provide barrier protection for newly planted areas or areas to be preserved.
C. Protect new plantings and plants to remain from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damage to new or existing plantings at the expense of the Landscape Contractor.
D. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner’s property.
E. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees free of insects and disease. Maintain throughout project work period until Substantial Completion. All plantings which appear to be in distress or defective shall be removed immediately and replaced or replanted according to planting times and quality as defined in this section, with specimens of the same species and size as originally specified:
F. Watering:
   1. The contractor shall be fully responsible to ensure that adequate water is provided to all plants throughout the work period until the date of Substantial Completion.
   2. Hand water root balls of all plants to ensure that the root balls have moisture
above wilt point and below field capacity, and appropriate for the species. As needed, moisture content in each root ball and soil outside the root ball can be tested to determine water content.

G. Guy Wires and Stakes are to be maintained by Contractor until the end of the Guarantee Period (see section 3.10) to avoid girdling throughout the first growing season, and removed after the first growing season if site conditions and adequate plant establishment permit.

3.11 ACCEPTANCE AND GUARANTEE

A. Plants are to be guaranteed as per the following list, starting from the time of Substantial Completion. Defective materials shall be removed immediately and replaced according to planting times and quality as defined in this section, with specimens of the same species and size as originally specified, with new guarantee for the replacement plant starting at time of replacement. Written Final Acceptance shall be provided at the end of the guarantee period by Owner Representative once all conditions of this Section have been met. All plants must be in a vigorous growing condition at the end of the guarantee period:

1. Minimum of 2-year guarantee on all newly installed plant material.

B. When Maintenance after Substantial Completion is by others, and not awarded to the Contractor:

1. After Substantial Completion Acceptance, the Contractor shall make sufficient site visits to observe the Owner’s maintenance and notify the Owner’s Representative in writing if maintenance, including watering, is not sufficient to maintain plants in a healthy condition. Such notifications must be made in a timely period so that the Owner can take corrective action and/or schedule a time to review with the Contractor prior to taking corrective action. Notification must define the maintenance needs observed, include a date and request for site review.

2. In the event that the Contractor fails to visit the site and/or notify the Owner’s Representative in writing, with confirmation that Owner’s Representative received the notification, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.

C. Contractor is to be responsible for contacting Owner’s Representative defined at the start of this section (1) one month prior to end of guarantee period to review health and successful establishment of plantings. Guarantee remains in effect until this final review takes place.

END OF SECTION
SECTION 33 41 00- STORM DRAINAGE AND SANITARY SEWER PIPING

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 gravity-flow storm drainage and sanitary sewer outside the building, with the following components:

1. PVC storm and sanitary pipe and fittings
2. RCP storm pipe and flared end sections
3. Cleanouts.
4. Area drains including trench drains.
5. Pre-cast concrete catch basins and manholes.
6. Pre-cast concrete pond outlet structure

1.3 DEFINITIONS

A. RCP: Reinforced concrete pipe
B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, pipe joints shall be at least silt-tight, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:

1. RCP Pipe and Fittings.
2. Cleanouts
3. Pre-cast Outlet Structure for Bio-Retention SWM Areas
4. Reinforced Concrete Flared End Sections
5. Trench Drains for Loading Area
6. Trench Drains for Dumpster Pad Areas.
7. Storm and Sanitary Structures (manholes, manhole seals, catch basins, etc.)

B. Shop Drawings: For the following:
1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
2. Catch Basins: Include plans, elevations, sections, details, and frames, covers, and grates.
3. Stormwater Pond Outlet Structure: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.
4. Diversion Structure (DS-1): Include plans, elevations, sections, details, and frames, covers, and grates.
5. HDPE to Concrete Connection: Provide ADS specifications or approved equal (as per drawing detail).

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle manholes according to manufacturer’s written rigging instructions.
D. Handle catch basin and pond outlet structure according to manufacturer’s written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Architect’s and/or Owner’s written permission.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 “Piping Applications” Article for applications of pipe, fitting, and joining materials.

2.3 PE PIPE AND FITTINGS

A. Corrugated PE Pipe and Fittings: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
   1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

2.4 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, 4” to 15” diameter: ASTM D 3034, SDR-26 with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

B. PVC Sewer Pipe and Fittings, 18” diameter and Larger: ASTM F 679, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.5 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe (RCP) and Fittings: ASTM C 76, with bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets.

2.6 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.7 CLEANOUTS

A. Gray-Iron Cleanouts (paved areas): ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:
   b. MIFAB Manufacturing, Inc.
2. Top-Loading Classification(s): Heavy duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts (lawn areas): Schedule-40 PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

1. Manufacturers:
   a. IPS Corporation.
   b. NDS Inc.

2.8 DRAINAGE STRUCTURES

A. Standard Precast Concrete Manholes, and Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 48 inches.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
12. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover using wording equivalent to “STORM SEWER.”

2.9 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.10 PIPE OUTLETS

A. Head Walls (N/A): Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Stilling Basins: Place as per DNREC standards and drawing detail with rip-rap size and thickness as specified on drawings.

2.11 STORMWATER INLETS

A. Gutter Inlets: Made with horizontal gutter openings as per DelDOT standards. Include heavy-duty frames and Type 3 Bicycle Safe grates.

B. Combination Inlets: Made with vertical curb and horizontal gutter openings as per DelDOT standards. Include heavy-duty frames and Type 3 Bicycle Safe grates.

C. Frames and Grates: Heavy duty frames and Type 3 Bicycle Safe grates.

2.12 STORMWATER DETENTION OUTLET STRUCTURE

A. Pre-Cast Concrete, Stormwater Detention Structures: Submit shop drawings for concrete structure, reinforcing design, slab, trash rack, orifice restrictor plate, and orifice protector.
C. Gravity-Flow, Nonpressure Sewer Piping: Use the following pipe materials for each size range:
   1. Reinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
   2. PVC sewer pipe and fittings, gaskets, and gasketed joints (NPS 4 and NPS 6).
   3. PVC sewer pipe and fittings, gaskets, and gasketed joints (NPS 8 to NPS 12).

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer’s written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer’s written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 0.005 ft/ft, unless otherwise indicated on plans.
   2. Install PE corrugated sewer piping according to CPPA’s “Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings.”
   3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
   4. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA’s “Concrete Pipe Installation Manual.”

3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 2 Section “Piped Utilities - Basic Materials and Methods.” Where specific joint construction is not indicated, follow piping manufacturer’s written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:
1. Join corrugated PE piping according to CPPA 100 and the following:
   a. Use silttight couplings for Type 1, silttight joints.
   b. Use soiltight couplings for Type 2, soiltight joints.

2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
4. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Medium-Duty, top-loading classification cleanouts in earth or unpaved/paved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in loading/vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep (or as per drawing detail). Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.7 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.
B. Set frames and grates to elevations indicated.

3.8 DRAIN INSTALLATION

A. Install type of drains in locations indicated.
   1. Use Light-Duty, top-loading classification drains in [earth or unpaved foot-traffic areas].
   2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
   3. Use Heavy-Duty, top-loading classification drains in loading/vehicle-traffic service areas.

B. Embed drains in 6-inch minimum concrete around bottom and sides (see drawing detail).

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in 6-inch minimum concrete around bottom and sides (see drawing detail).

3.9 STORM PIPE OUTLET INSTALLATION

A. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

3.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.11 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.
3.12 DRAINAGE SYSTEM INSTALLATION

A. Assemble and install components according to manufacturer’s written instructions.

B. Install with top surfaces of components, except piping, flush with finished surface.

C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

3.13 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

B. Connect force-main piping to building's storm drainage force mains specified in Division 22 Section "Facility Storm Drainage Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
D. Connect to sediment interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

E. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Flexible couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.14 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

   1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
   2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

   1. Remove manhole or structure and close open ends of remaining piping.
   2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.15 IDENTIFICATION

A. Materials and their installation are specified in division 2 Section “Earthwork.” Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.16 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

3.17 CLEANING

A. Clean interior of piping, flared end sections, and structures of dirt and superfluous materials as directed by CCR and Engineer.

END OF SECTION 33 41 00