PROJECT MANUAL

D.P. CULP EXPANSION & RENOVATION FOR
EAST TENNESSEE STATE UNIVERSITY

RELEASE PACKAGE 2
50% REVIEW SET

SBC Project No. 166/005-01-2014CM

PREPARED FOR:
OWNER

TENNESSEE BOARD of REGENTS
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PREPARED BY:

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FACILITIES SYSTEMS CONSULTANTS, LLC.
MECHANICAL, PLUMBING & ELECTRICAL ENGINEERING

ROSS/FOWLER LANDSCAPE ARCHITECTURE URBAN DESIGN & PLANNING
LANDSCAPE ARCHITECT

CONSTRUCTION DOCUMENTS
October 17, 2017
PROJECT DIRECTORY AND DESIGNERS’ SEALS

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END OF SECTION
**TABLE OF CONTENTS**

00 00 01  Cover Sheet
00 01 07  Project Directory / Seals  2
00 01 10  Table of Contents  6

**DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS**

**BIDDING REQUIREMENTS**

*Obtain Bid Forms and requirements from TBR*

| 00 11 19  | Request for GMP Proposal  | [TBR]  | (to be issued in 100% CD phase) |
| 00 21 19  | Instructions to GMP Proposer | [TBR]  | 2 |
| 00 31 26  | Asbestos Survey Information Available to Bidders | [TBR]  | 1 |
| 00 31 32  | Geotechnical Information Available to Bidders | [TBR]  | 1 |
| 00 36 66  | Owner’s Central Office Accessibility | [TBR]  | 1 |
| 00 42 23  | Proposal Summary | [TBR]  | 1 |
| 00 42 71  | Proposal of Trade Subcontracts | [TBR]  | 1 |
| 00 42 75  | Proposal of General Conditions | [TBR]  | 1 |

**CONTRACTING REQUIREMENTS**

*The Contract for Construction will be prepared by TBR*

| 00 61 43  | Three Year Roof Bond | [TBR]  | 2 |
| 00 72 13  | General Conditions (AIA A201) | [TBR]  | 51 |
| 00 73 16  | Supplementary Conditions | [TBR]  | 1 |

AIA based general / supplementary conditions to be specified / referenced by Moody Nolan, Inc:

| 00 73 00  | Supplementary Conditions (A/E governing conditions) | [TBR]  | (to be issued in 100% CD phase) |

**DIVISION 01 - GENERAL REQUIREMENTS**

| 01 11 00  | Summary of Work | [MNI]  | 2 |
| 01 21 13  | Allowances  | [TBR]  | (to be issued in 100% CD phase) |
| 01 21 15  | List of Allowances | [TBR]  | (to be issued in 100% CD phase) |
| 01 23 00  | Alternates  | [TBR]  | (to be issued in 100% CD phase) |
| 01 25 13  | Product Substitution Procedures | [TBR]  | 1 |
| 01 25 33  | Product Substitution Request Form | [TBR]  | 2 |
| 01 26 00  | Contract Modification Procedures | [TBR]  | 1 |
| 01 26 20  | Weather Delays | [TBR]  | 2 |
| 01 26 25  | Weather Delay Report | [TBR]  | 1 |
| 01 26 40  | Forms for Amendment, Change Order or Directive | [TBR]  | 1 |
| 01 26 54  | Form for Price Summary | [TBR]  | 1 |
| 01 26 55  | Form for Price of Work | [TBR]  | 1 |
| 01 26 56  | Form for Price of Time | [TBR]  | 1 |
| 01 29 16  | CM/GC-GMP Contingency | [TBR]  | 2 |
| 01 29 17  | CM/GC-GMP Contingency Log | [TBR]  | 1 |
| 01 29 18  | CM/GC-GMP Reserve Fund Log | [TBR]  | 1 |
| 01 29 54  | Retainage Escrow Initiation | [TBR]  | 2 |
| 01 29 73  | Schedule of Values | [TBR]  | 1 |
| 01 29 76  | Applications and Certificates for Payment | [TBR]  | 3 |
TABLE OF CONTENTS

01 31 00 Project Management and Coordination [MNI] 5
01 31 19 Project Meetings [TBR] 1
01 31 90 Administrative Logs [TBR] 1
01 32 15 Progress Schedules and Reports [TBR] 1
01 33 23 Shop Drawings, Product Data and Samples [MNI] 8
01 35 13 Special Project Procedures [MNI] 2
01 40 00 Quality Control [MNI] 2
01 41 13 Fire Resistance Rating Requirements [MNI] 2
01 41 15 Basic Regulatory Requirements [TBR] 2
01 43 25 Testing Laboratory Services [TBR] 1
01 45 33 Special Inspections and Structural Tests [MNI] 2
01 50 00 Temporary Facilities and Controls [MNI] 7
01 57 23 Temporary Storm Water Pollution Control [TBR] 2
01 60 00 Product Requirements [MNI] 5
01 62 25 Product Options [TBR] 1
01 71 23 Field Engineering [MNI] 2
01 73 00 Execution Requirements [MNI] 6
01 73 29 Cutting and Patching [MNI] 4
01 74 00 Cleaning [MNI] 5
01 74 19 Construction Waste Management and Recycling [MNI] 7
01 77 70 Close-out Procedures [TBR] 2
01 78 21 Close-out Submittals [TBR] 1
01 78 25 Data Binder Receipt [TBR] 1
01 78 88 Report of Subcontractors and Suppliers [TBR] 1
01 79 21 Demonstration and Training [TBR] 1
01 79 25 Demonstration and Training Verification [TBR] 2
01 91 13 Commissioning [TBR] 3
01 91 23 Performance Testing Identification Form [TBR] 1
01 91 26 Performance Testing Procedures Form [TBR] 1
01 91 29 Functional Performance Test Certification [TBR] 1

DIVISION 02 – EXISTING CONDITIONS
02 32 01 Geotechnical Investigations 1
02 41 13 Selective Site Demolition EOR section
02 41 19 Selective Building Demolition 6

DIVISION 03 - CONCRETE
03 01 30 Concrete Sealing and Cleaning 3
03 01 40.72 Strengthening of Precast Concrete [RBA] 5
03 01 31 Concrete Patching 3
03 01 32 Cementitious Leveling 3
03 01 33 Concrete Rehabilitation 2
03 10 00 Concrete Forming and Accessories [RBA] 5
03 20 00 Concrete Reinforcing [RBA] 2
03 30 00 Cast-In-Place Concrete [RBA] 10
03 33 00 Cast-In-Place Architectural Concrete 10
03 35 20 Colored Concrete Stain Finish 4
03 45 00 Architectural Precast Concrete [R / F] 9

D.P. Culp Center [TBR SBC No. 166/005-01-2014A] 00 01 10 - 2
East Tennessee State University 50% CD TABLE OF CONTENTS
<table>
<thead>
<tr>
<th>DIVISION 04 - MASONRY</th>
<th>TBR sections</th>
<th>EOR sections TBD</th>
<th>TBD</th>
<th>consultants sections</th>
<th>scope to be verified</th>
</tr>
</thead>
<tbody>
<tr>
<td>04 01 21 Masonry Restoration and Cleaning</td>
<td>TBR</td>
<td>TBD</td>
<td>TBD</td>
<td>§</td>
<td>to be issued at 100%</td>
</tr>
<tr>
<td>04 22 00 Concrete Unit Masonry</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be verified</td>
</tr>
<tr>
<td>04 43 10 Limestone</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be verified</td>
</tr>
<tr>
<td>04 72 00 Cast Stone</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be verified</td>
</tr>
<tr>
<td>04 73 13 Calcium Silicate Manufactured Stone</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be verified</td>
</tr>
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<table>
<thead>
<tr>
<th>DIVISION 05 - METALS</th>
<th></th>
<th>TBD</th>
<th>TBD</th>
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<th>to be issued in 100% CD phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>05 12 00 Structural Steel Framing</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>05 21 00 Steel Joist Framing</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>05 31 00 Steel Decking</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>05 50 00 Metal Fabrications</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>05 51 00 Metal Stairs</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>05 52 15 Illuminated Handrail</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>05 58 13 Column Covers</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>05 70 00 Decorative Metals</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>05 72 00 Ornamental Handrails &amp; Railings</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>DIVISION 06 – WOOD, PLASTICS AND COMPOSITES</th>
<th></th>
<th>TBD</th>
<th>TBD</th>
<th>§</th>
<th>to be issued in 100% CD phase</th>
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</thead>
<tbody>
<tr>
<td>06 10 00 Rough Carpentry</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>06 20 00 Finish Carpentry</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>06 40 00 Architectural Woodwork</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIVISION 07 - THERMAL &amp; MOISTURE PROTECTION</th>
<th></th>
<th>TBD</th>
<th>TBD</th>
<th>§</th>
<th>to be issued in 100% CD phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>07 10 00 Waterproofing</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 11 13 Bituminous Dampproofing</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 21 00 Thermal Insulation</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 27 26 Fluid Applied Membrane Vapor/Air Barriers</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 42 13 Metal Wall Panels</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 50 36 Total Roofing System Warranty</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 53 23 Elastomeric Membrane Roofing – EPDM</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 62 00 Sheet Metal Flashing and Trim</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 81 10 Sprayed-Applied Fireproofing</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 84 00 Firestopping</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 91 13 Compression Joint Seals</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 92 00 Sealants</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>07 95 13 Expansion Joint Cover Assemblies</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>DIVISION 08 - DOORS &amp; WINDOWS</th>
<th></th>
<th>TBD</th>
<th>TBD</th>
<th>§</th>
<th>to be issued in 100% CD phase</th>
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<tbody>
<tr>
<td>08 11 13 Hollow Metal Doors and Frames</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 14 00 Wood Doors</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 31 13 Access Doors</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 33 23 Coiling Overhead Doors</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 33 26 Overhead Coiling Grilles</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 34 73 Sound Control Door Assemblies</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 34 97 Fixed Fabric Draft Curtain</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 41 13 Aluminum-Framed Entrances and Storefronts</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 44 13 Glazed Aluminum Curtainwalls</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 71 10 Finish Hardware</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 71 13 Automatic Door Operators</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>08 81 00 Glass and Glazing</td>
<td></td>
<td>TBD</td>
<td></td>
<td>§</td>
<td>to be issued in 100% CD phase</td>
</tr>
<tr>
<td>TBR sections</td>
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<td>to be issued at 100%</td>
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</tr>
<tr>
<td>08 83 00</td>
<td>Mirrors</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>08 91 19</td>
<td>Fixed Louvers</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**DIVISION 09 - FINISHES**

| 09 21 16     | Gypsum Board Systems |                      |                      | 15  |                |
| 09 27 13     | Glass Fiber Reinforced Gypsum Shapes | TBD / issued in 100% CD phase | | |
| 09 30 00     | Tile                 |                      |                      | 12  |                |
| 09 51 13     | Acoustical Panel Ceilings |                      |                      | 7   |                |
| 09 65 00     | Resilient Flooring   |                      |                      | 13  |                |
| 09 67 23     | Resinous Flooring    |                      |                      | 5   |                |
| 09 68 00     | Carpeting            |                      |                      | 10  |                |
| 09 69 00     | Access Flooring      | TBD / issued in 100% CD phase | | |
| 09 72 16     | Vinyl Coated Fabric Wall Coverings | TBD / issued in 100% CD phase | | |
| 09 77 26     | Dry Erase Wall Covering | TBD / issued in 100% CD phase | | |
| 09 77 27     | Tackable Wall Covering |                      |                      | 4   |                |
| 09 84 13     | Sound Absorbing Wall Units [consultant] | | | |
| 09 91 00     | Painting             |                      |                      | 19  |                |

**DIVISION 10 - SPECIALTIES**

| 10 11 00     | Visual Display Surfaces |                      |                      | 5   |                |
| 10 14 10     | Interior Signage       |                      |                      | 6   |                |
| 10 14 19     | Dimensional Letters    |                      |                      | 3   |                |
| 10 21 14     | Plastic Toilet Compartments |                      |                      | 4   |                |
| 10 22 26     | Folding Panel Partitions |                      |                      | 5   |                |
| 10 26 00     | Wall Protection        |                      |                      | 5   |                |
| 10 28 13     | Toilet Accessories     |                      |                      | 7   |                |
| 10 44 00     | Fire Extinguishers and Cabinets |                      |                      | 4   |                |
| 10 51 13     | Metal Lockers          |                      |                      | 5   |                |
| 10 55 23     | Mailboxes              |                      |                      | 1   |                |

**DIVISION 11 - EQUIPMENT**

| 11 24 23     | Window Washing System  |                      |                      | 6   |                |
| 11 40 00     | Food Service Equipment [X-C section] |                      |                      | 15  |                |
| 11 52 13     | Projection Screens     |                      |                      | 2   |                |
| 11 52 23     | Television Mounting Brackets |                      |                      | 2   |                |

**DIVISION 12 - FURNISHINGS**

| 12 22 15     | Black-Out Drapes       |                      |                      | 2   |                |
| 12 24 13     | Roller Window Shades   |                      |                      | 8   |                |
| 12 46 19     | Clocks                |                      |                      | 1   |                |
| 12 48 13     | Entrance Mats          |                      |                      | 1   |                |
| 12 93 00     | Site Furnishings [R / F] |                      |                      | 9   |                |

**DIVISION 13 - SPECIAL CONSTRUCTION**

| 13 48 00     | Sound and Vibration Control |                      |                      |     |                |
| 13 48 66     | Prefabricated Audiometric Rooms | [consultant sections] | | |
| 13 49 00     | RF Shielding Enclosure    | [consultant sections] | | |

**DIVISION 14 - CONVEYING EQUIPMENT**

| 14 21 23     | Electric Traction Passenger Elevators [TBD / issued in 100% CD phase] | | | | |

D.P. Culp Center [TBR SBC No. 166/005-01-2014A] 00 01 10 - 4
East Tennessee State University 50% CD TABLE OF CONTENTS
## DIVISION 21 - FIRE SUPPRESSION
21 10 00 Fire Protection

## DIVISION 22 - PLUMBING
22 05 00 General Provisions for Plumbing
22 05 53 Identification of Plumbing & Piping Equipment
22 07 19 Plumbing Insulation
22 10 05 Plumbing Piping & Valves
22 10 06 Plumbing Piping Specialties

## DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING
23 05 05 Use of Mechanical Systems
23 05 13 Motor Requirements for HVAC Equipment
23 05 14 Variable Frequency Motor Drives
23 05 17 Sleeves, Escutcheons, & Sleeve Seals for HVAC Piping
23 05 29 Hangers & Supports for HVAC Piping & Equipment
23 05 33 Heat Tracing for Exterior Chilled Water Piping
23 05 48 Vibration Isolation for HVAC
23 05 53 Identification of HVAC & Piping Equipment
23 05 93 Testing, Adjusting & Balancing for HVAC
23 07 13 Duct Insulation
23 07 19 HVAC Equipment & Piping Insulation
23 09 23 Direct Digital Control (DDC) System for HVAC
23 21 13 Hydronic Piping
23 21 14 Exterior & Underground Chilled Water Distribution Systems
23 21 16 Hydronic Piping, Valves & Specialties
23 21 23 Hydronic Pumps
23 31 13 Sheet Metal Ductwork – Low Pressure
23 31 15 Sheet Metal Ductwork – Medium Pressure
23 34 23 HVAC Power Ventilators
23 36 00 Air Terminal Units
23 37 13 Sheet Metal Specialties
23 41 00 Air Filters
23 51 23 Gas Vents
23 64 23 Scroll Water Chillers
23 73 13 Modular Indoor Central Station Air Handling Units
23 74 13 Modular Outdoor Central Station Air Handling Units
23 82 19 Fan Coil Units

## DIVISION 26 - ELECTRICAL
26 05 00 Electrical General Provisions
26 05 01 Basic Electrical Materials & Methods
26 05 16 Conduit
26 05 19 Wire & Cable
26 05 26 Grounding & Bonding
26 05 29 Supporting Devices
26 05 33 Outlet & Junction Boxes
26 05 53 Electrical Identification
26 05 73 Overcurrent Protective Devices
26 22 00 Dry Type Transformers
26 24 00 Mechanical Equipment & Controls
Table of Contents

Division 26 – Panelboards
- 26 24 16 Panelboards
- 26 27 01 Electrical Service Entrance
- 26 27 26 Wiring Devices & Plates
- 26 28 13 Disconnect Switches
- 26 32 13 Generator Set
- 26 36 00 Automatic Transfer Switches
- 26 43 13 Transient Voltage Surge Suppressors
- 26 51 00 Interior Lighting
- 26 61 00 General Lighting Provisions

Division 27 – Communications
- 27 01 00 Reference Standards
- 27 05 28 Telecommunications Outside Plant (OSP)
- 27 05 29 Hangers & Support
- 27 05 53 Administration Labeling
- 27 11 10 Telecommunications Spaces
- 27 15 00 Voice & Network Horizontal Cabling System
- 27 15 33 Coax Horizontal Cabling

Division 28 – Electronic Safety and Security
- 28 03 00 Fire Alarm System

Division 31 – Earthwork
- 31 00 00 Site Preparation
- 31 20 00 Earthwork
- 31 22 00 Excavation, Backfilling and Compaction
- 31 22 10 Grading
- 31 22 81 Termite Control
- 31 25 00 Erosion and Sediment Control
- 31 25 00 Landscape Boulders & River Stone
- 31 62 23 Drilled Steel Minipiles (Micropiles)

Division 32 – Exterior Improvements
- 32 10 00 Asphalt Concrete Pavement
- 32 13 16 Concrete Pavement
- 32 16 00 Concrete Curbs and Walks
- 32 16 24 Brick Pavers
- 32 17 23 Pavement Markings
- 32 31 21 Aluminum Louver Fencing
- 32 91 19 Topsoiling and Finish Grading
- 32 84 23 Irrigation
- 32 92 19 Sodding, Seeding and Groundcover

Division 33 – Utilities
- 33 05 00 Common Work for Utilities
- 33 27 20 Site Drainage System
- 33 46 13 Foundations Drainage System

Division 41 – Material Processing and Handling Equipment
No work proposed or sections required for this Contract
INSTRUCTIONS TO CM/GC FOR PRODUCING THE GMP

A. Subcontractors that have been disqualified from participating in State Building Commission projects may not be recommended for any part of this Work, and shall not be allowed to perform any part of this Work. The CM/GC and its subcontractors shall not knowingly utilize the services of an illegal immigrant in the performance of this Work, and shall not knowingly utilize the services of any subcontractor, sub-subcontractor, or consultant who utilizes the services of an illegal immigrant in the performance of this Work.

B. The CM/GC shall present the GMP with an acknowledgement of all addenda.

C. If the GMP includes work of a subcontract trade regulated by state licensing laws, the CM/GC shall identify the subcontractor’s license information called for by licensing law.

D. The CM/GC shall provide the following information explaining the derivation of costs:

1. Standard forms provided for documenting the GMP are recommended for the convenience of the Owner, to provide the CM/GC with a basic format most easily evaluated and accepted by the Owner. These forms are reproduced in this project manual, and are available as Excel spreadsheets in the Designers’ Manual posted on the Owner’s website. Standard forms include:
   - Section 00 42 23 GMP Summary
   - Section 00 42 71 GMP List of Trade Subcontracts
   - Section 00 42 75 GMP Disclosure of General Conditions
   - Section 01 26 55 Form for Price of Work

2. Provide a Cumulative Summary when adding scope or phases to an existing GMP Contract, and show the history of the current GMP, and the effect of the amending the new GMP to the existing GMP. No standard form is provided, but a format similar to the GMP Summary is preferred.

3. GMP Summary shall show the cost elements of trade subcontracts, general conditions, self-performance, CM/GC contingency, fee, and a total of these, with percentages for self-performance, contingency, and fee. If alternates are required and/or volunteered, these shall be shown distinct from the cost of the base work, and the cost elements named above provided for each. The standard form accommodates this information as if there are three required and three volunteered alternates; however, it is not intended to infer a required number of alternates for a particular project. The Owner normally expects quality pre-construction services to produce no alternates.

4. GMP List of Trade Subcontracts shall show hard bids distinct from allowances and estimates. If there are alternates, these shall be shown distinct from the cost of the base work, similar to the GMP Summary. The standard form accommodates this information. List only those allowances that are specified. If an allowance is part of a trade subcontract, show the allowance portion as an allowance, and show the remainder of the trade in the Estimates or Hard Bids, as applicable. Trades may only be so designated to the extent that they are being procured through bidding, either before or after the GMP agreement or amendment, in accordance with the Master Contract. Portions of the Work that the CM/GC will procure through direct purchase without bidding cannot be Trades, and must be a part of Self-Performance. An exception to the requirement of bidding a trade can be in accordance with specification section 01 29 16 paragraph 1.03.F.

5. Bid Tabulation of Trade Subcontracts shall show the various trade bids in a manner that facilitates easy comparison and determination of the low bidder, with notations explaining post-bid adjustments and rejections. Copies of the bids shall also be provided, to allow the Designer and Owner the opportunity to correlate the Bid Tabulation to the bids. No standard format is provided.
6. The Self-Performance portion of the GMP shall be itemized using the Form for Price of Work, showing the costs, overhead, and profit in a manner similar to that required for change order price itemization. The standard form accommodates this information.

7. GMP Disclosure of General Conditions shall list the line items included in the original proposal by which the CM/GC was selected, and the comparable costs included in the specific GMP being presented, identifying and explaining deviations. The standard form accommodates this information based on commonly used line items, but is not necessarily all-inclusive of line items applicable in this instance.

E. The proposal is to be submitted to the Owner and copied simultaneously to the Designer.

F. Once submitted, the proposal must be firm for thirty (30) days for the Owner to evaluate and complete the award or amendment, including five (5) days allowed for the proposer to sign and return award or amendment documents, once provided by the Owner, plus all required bonds and insurance documents.

END OF SECTION
ASBESTOS SURVEY
INFORMATION AVAILABLE TO BIDDERS

ASBESTOS INVESTIGATION AND REPORT:

A. An investigation has been performed at the project site to determine the presence and probable extent of asbestos in the existing building materials. This investigation was conducted, and a report obtained, solely for design purposes and is not a part of the Contract Documents.

B. The use and interpretation of this information is entirely the responsibility of the using party. The Owner is not responsible for variations in the actual composition of existing materials. Bidders shall decide for themselves the character of the material to be encountered.

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

SUB-SURFACE INVESTIGATION AND REPORT:

A. Sub-surface investigation has been performed at the project site. This investigation was conducted, and a report obtained, solely for design purposes and is not a part of the Contract Documents.

B. The use and interpretation of this information will be entirely the responsibility of the using party. The Owner is not responsible for variations in the sub-surface conditions. Bidders shall decide for themselves the character of the material to be encountered.

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

A. The Office of Facilities Development (OFD) physical and mailing address at the Tennessee Board of Regents (TBR) system office is:

Tennessee Board of Regents
Office of Facilities Development
1 Bridgestone Park
Nashville, Tennessee 37214-2428

B. The general contact phone number for TBR OFD is 615-366-4431.

1.02 ACCESS TO TBR SYSTEM OFFICE

A. Meetings related to OFD projects may occur on-site or elsewhere at the involved institution, the designer’s or contractor’s office, or the TBR system office, as befits the needs of those organizing the meeting. Public bid openings are considered meetings.

B. The 1 Bridgestone Park Building is in general an ADA compliant accessible building.

C. **Anyone who wishes to enter** the TBR System Office, whether to attend a meeting or deliver a bid or proposal or any other purpose, should contact one of the staff members shown below, or the staff member specifically hosting the meeting if known, and make known their intent to enter. Contact may be made in person, by writing, by email, by telephone, or otherwise, and should be received no later than 4:30pm on the third TBR business day prior to the arrival, unless specifically announced otherwise.

- **For meetings related to bid or proposal solicitations**
  - Rilla Froggatt
  - 615-366-3908
  - rilla.froggatt@tbr.edu

- **For other meetings and as back-up to Ms. Froggatt**
  - Tammy Ray
  - 615-366-4493
  - tammy.ray@tbr.edu

D. **Anyone with a disability**, when making their intent to attend a meeting known, per C above, should also at that time request services needed to facilitate attendance. TBR staff responding to such requests will obtain specific information and coordinate accommodations with building management personnel, and then advise the person who made the request.

END OF SECTION
# GMP SUMMARY

**Project:**
give SBC project number and name

**Presented by CM/GC:**
fill in name of CM/GC

<table>
<thead>
<tr>
<th>date</th>
<th>Base Work</th>
<th>Specified Alternates</th>
<th>Volunteered Alternates</th>
<th>Total if all accepted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#1</td>
<td>#2</td>
<td>#3</td>
<td>#4</td>
</tr>
<tr>
<td>fixed fee percentage</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>contingency percentage</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

| Allowances | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Estimates   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hard Bids   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Trade Subcontracts**

|                      | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Self Performance**

|                      | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**General Conditions**

|                      | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**CM/GC Contingency**

|                      | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Fixed Fee**

|                      | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**GMP Totals**

|                      | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

self-performance (% of GMP):
ctgcy (% of trades, GCs, Self):
fee (% of GMP):

GMP Summary
00 42 23 - 1

Posted in XLS format
February 2016 OFD s004223
Page 1 of 1
# GMP List of Trade Subcontracts

**Project:**
give SBC project number and name

**Presented by CM/GC:**
fill in name of CM/GC

<table>
<thead>
<tr>
<th></th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>Total if all accepted</th>
</tr>
</thead>
<tbody>
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<td>Base Work</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specified Alternates</td>
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</tr>
<tr>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

| Volunteered Alternates |    |    |    |    |    |    |                       |
| #4            | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| #5            | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| #6            | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total         | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Total if all accepted |    |    |    |    |    |    |                       |
|                       | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Trade allowances subtotals: 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Trade estimates subtotals: 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Trade bid subtotals: 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Trades totals: 0.00 0.00 0.00 0.00 0.00 0.00 0.00

---

**GMP List of Trade Subcontracts**

**00 42 71 - 1**

*February 2016 OFD s004271*

*Page 1 of 1*
# GMP Disclosure of General Conditions

<table>
<thead>
<tr>
<th>SBC Project Number</th>
<th>TBR Institution</th>
<th>Project Name</th>
<th>Owner:</th>
<th>Tennessee Board of Regents</th>
<th>CM/GC:</th>
</tr>
</thead>
</table>

## General Conditions Costs

<table>
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<tr>
<th>Date</th>
<th>Original Proposal</th>
<th>This GMP</th>
<th>Deviation</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>monthly</td>
<td>monthly</td>
<td>monthly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Photographs
- Superintendent
- Clerk
- Asst Superintendent
- Project Manager
- Project Director
- Project Engineer / Safety
- Layout Instruments
- Temporary Office Trailer
- Temporary Storage Trailer
- Portable Toilets
- Temporary Utilities
- Employee Parking
- Phones & Beepers
- Safety Measures
- Trash Collection & Disposal
- Pick-up Truck
- Auto
- Fuel
- Office Furniture & Equipment
- Misc Supplies & Expenses
  - monthly subtotal
- monthly Contract Time
  - monthly x months
- lump sum

- Permits
- GL, auto, empl Insurance
- Builder's Risk Insurance
- Other Insurance (explain)
- Bond
- Gross Receipts Tax
- Signs
- Other Temporary stuff
- Misc Printing
  - lump sums subtotal

- Total

---

*Posted in XLS format*

*General Work for CM/GC*

*February 2016 OFD s004275 page 1 of 1*
THREE YEAR ROOF BOND
standard form for construction contracts under the State Building Commission of Tennessee

BOND NO. ____________________

GENERAL INFORMATION:

Principal: ___________________________________________________________

Surety (Name): _______________________________________________________

(Address): ___________________________________________________________

Building Owner: _____________________________________________________

Project: _____________________________________________________________

Project Contract Date: ________________________________________________

KNOW ALL MEN BY THESE PRESENTS:
That we, the Principal and the Surety, are held and firmly bound unto the Building Owner in the amount of

for the payment thereof in good and lawful money of the United States of America the Principal and the Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

Whereas, Principal has, by written agreement referenced above, entered into a contract (hereinafter referred to as "the Contract" and hereby referenced herein) with the Owner for the construction of the Project identified above.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal shall fully indemnify the Owner for all loss that the Owner may suffer by reason of any defective material and/or workmanship in the materials furnished for and the installation of the above referenced Project roofing system which become apparent during the period of three (3) years from the date of Substantial Completion of the above referenced Project roofing system, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Surety hereby agrees that no change, extension of time, alteration or addition to the terms of the contract or to the Work to be performed thereunder or to the specifications accompanying the same shall in any way affect the obligations under this bond, and notice is hereby waived of any such change, extension of time, alteration or addition to the terms of the contract or to the Work or to the specifications.
IN WITNESS WHEREOF the Principal has hereunto affixed its signature and Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this ____ day of __________, 20__. 

Executed in __________ counterparts.

Witness:

__________________________  ____________________________
(name of Principal)  (name of Surety)

__________________________  ____________________________
(authorized signature)  (signature of Attorney-in-fact)

__________________________  ____________________________
(name of signatory)  (name of Attorney-in-fact)

__________________________  ____________________________
(title of signatory)  (Tennessee license number of Agent or Attorney-in-fact)

__________________________  ____________________________
(countersignature of resident Agent if not same as Attorney-in-fact)

Surety Company issuing bond shall be licensed to transact business in State of Tennessee by Tennessee Department of Commerce and Insurance. Bonds shall have certified and current Power-of-Attorney for the Surety's Attorney-in-Fact attached. Attorney-in-fact who executes bond on behalf of Surety shall be licensed by and a resident of State of Tennessee, and shall affix license number to bond; or, countersignature by a licensed agent who is a resident of State of Tennessee, and the agent's license number, shall be affixed to the bond in addition to the signature of the Attorney-in-Fact.
SUPPLEMENTARY CONDITIONS
REGARDING ALL CONTRACTS USING OFD CONDITIONS FOR GENERAL WORK.

MODIFICATIONS TO
OFD s007213 for General Work
(a modified AIA Document A201-1997)

GENERAL CONDITIONS
OF THE CONTRACT FOR CONSTRUCTION

The following supplements modify, change, delete from or add to "General Conditions of the Contract for Construction", and any other Conditions preceding these by section number for this Contract. Where a portion of Conditions is altered by these Conditions, the unaltered portion shall remain in effect.

--------------------------- ARTICLE 1 ---------------------------

GENERAL PROVISIONS

Add the following section:

1.1.4 The Project

Add to this section:

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

--------------------------- ARTICLE 3 ---------------------------

CONTRACTOR

3.4.7 Prevailing Wage Scale:

Delete this section in its entirety.

Add the following section:

3.22 Financial Records:

3.22.1 The Contractor shall maintain documentation for all charges under this Contract. The books, records, and documents of the Contractor, insofar as they relate to work performed or money received under this contract, shall be maintained for a period of three (3) full years from the date of the final payment and shall be subject to audit at any reasonable time and upon reasonable notice by the State, the Comptroller of the Treasury, or their duly appointed representatives. The financial statements shall be prepared in accordance with generally accepted accounting principles.

--------------------------- ARTICLE 9 ---------------------------

PAYMENTS and COMPLETION

9.10.6 Add: “If there is no Contract Bond, the final Certificate may be withheld until the prospect of final payment is advertised 30 days for the benefit of those to whom the Contractor may be indebted.”

--------------------------- ARTICLE 11 ---------------------------

INSURANCE and BONDS

11.1.1.5 Delete “other than to the Work itself”.

Add the following section:

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

11.3.1 Delete first sentence and substitute: “The Contractor shall purchase from and maintain, with a company or companies licensed to do business in Tennessee by the Department of Commerce and Insurance, property insurance written on a builder’s risk “all risk” or equivalent policy form in the amount of the initial Contract Sum plus value of subsequent Contract modifications for the covered project at the site on a replacement cost basis.”

11.3.1.1 Delete the last two sentences and substitute, “Any deductibles shall be the responsibility of the Contractor.”

11.3.1.2 Delete this section.

11.3.1.4 Delete the clause in its entirety and substitute: This property insurance shall cover portions of the work stored off the site and also portions of the work in transit. The Contractor shall present a certificate of insurance demonstrating coverage of the property stored off the site or in transit at the time payment for that portion of the work is presented.

11.3.2 At beginning of first sentence delete “The Owner shall purchase…” and substitute “The Contractor shall purchase…”.

11.3.6 Substitute all references to “Owner” with “Contractor”, and substitute all references to “Contractor” with “Owner”.

11.3.8 Delete clause.

11.3.9 At the end of the section delete all after “shall be performed by the Contractor”.

END OF SECTION
PART 1  GENERAL

1.01  GENERAL PROJECT DESCRIPTION

A. Project Description: The ETSU Culp Center Renovation is the construction of an addition and renovation of the DP Culp Center on the Campus of East Tennessee State University. Construction will be on the 3-story facility with 28,000 sf of addition and 135,000 sf of renovation.

B. The Project is being constructed under a single phase Contract.

C. A geotechnical engineering subsurface investigation will be performed for this project. The report will be made available to all bidders.

1.02  DESCRIPTION OF WORK

A. The following is a brief description of Contract Work for this project:

The early release package will be the installation of the site utilities and ordering of Structural Steel for the ETSU Culp Center Renovation. Site Utilities portion of work will be to prepare the underground utilities that are being relocated. The building will be in full operation with existing equipment during this portion of work and the switch over will occur during the main renovation package.

1.03  PROJECT SCHEDULE

A. Prepare a detailed construction procedure and schedule and submit it to the A / E for approval. Such procedure and schedule must be approved in writing by the A/E prior to the start of construction work.

B. Completion of the work within the time frame allotted is critical to the project and the schedule will be strictly adhered to. Contractor shall be responsible for the expediting of the fabrication and delivery of materials and equipment and shall coordinate delivery of same with the approved construction schedule to allow for completion within the time period specified in the Form of Proposal.

1. It is recognized that the work can be unavoidably affected or influenced by governing regulations, natural phenomena including weather conditions and other forces outside the Contract Documents. However, every effort must be made to keep the project on schedule due to the firm deadline established by the Owner for this particular phase of the work.

1.04  MISCELLANEOUS PROVISIONS

A. Performance Requirements for Completed Work: Provide the final and completed project complete and ready for use in every respect by the completion date
PART 1 - GENERAL

1.01 SUBSTITUTIONS:

A. Substitute products should not be ordered and shall not be installed without written approval or acceptance from Designer. Contractor assumes all risks associated with premature ordering and installation of substitute products.

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

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

1.02 SUBSTITUTION REQUEST FORM:

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

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

END OF SECTION
SECTION 01 25 33
PRODUCT SUBSTITUTION REQUEST FORM

To: ___________________________  Project: ___________________________

Attn: ___________________________

Specified Item: ___________________________

Proposed Substitute: ___________________________

1. The following are attached (Mark all that apply):
   - Complete Description
   - Laboratory Tests
   - Information on the availability of maintenance services and replacement materials for proposed substitute(s)
   - Catalog
   - Spec Data
   - Names, addresses, and phone numbers of fabricators and suppliers for proposed substitute(s)

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

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

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

5. This substitution will have the following effect on construction Schedules:

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

7. Manufacturers guarantees for the substitute(s) and the specified product(s) are (check one):
   - the same
   - different (If different, explain below)
8. If the proposed substitution is accepted, it will result in:
   [ ] no cost impact   [ ] a cost increase of
   [ ] a cost decrease of
   (If change in cost is indicated, itemization on specified Cost Itemization Form is attached)

9. License fees or royalties are pending on the proposed substitute.
   [ ] No   [ ] Yes (if yes, explain below)

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

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

   Submitted by:
   Sign here: ___________________________  Date: ___________________________

   Name: ______________________________  Telephone: ______________________
   type or print: ________________________
   for: ________________________________
   Name of firm: ________________________

   Address:
   Street address: ______________________
   and mailing address: __________________
   if different: ________________________
   City, State, and Zip Code: __________________

   Designer's Review Comments:
   [ ] Accepted   [ ] Rejected
   [ ] Accepted as noted   [ ] Rejected (received too late)
   [ ] Rejected (submittal incomplete)

   Additional comments: _______________________________________________________

   For the Designer:
   Signature here: ___________________________  Date: ___________________________
PART 1 - GENERAL

1.01 SUPPORTING DOCUMENTATION for PROPOSALS or CLAIMS


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

   C. For a change in Contract Sum, state briefly the reason for change, state the amount, and provide itemization of values on the following forms, or similar forms providing the same information:

      1. Section 01 26 54 Form for Price Summary: listing the itemizations of work by subcontractors and the Contractor that together apply to an entire related change in work.

      2. Section 01 26 55 Form for Price of Work: detailing the quantities, units, costs, and extensions for materials, equipment, and labor, subtotaled, plus overhead, and profit related to a specific proposed change in the Work.

      3. Section 01 26 56 Form for Price of Time: if applicable, deriving an average cost per day.

   D. For a change in Contract Time:

      1. Fully describe the extent of and reasons for the change and effect of the change on the construction schedule, and attach a revised Progress Schedule. Take into account weekends, holidays, and the specified standard baseline for weather delays during the period of the requested extension.

      2. For a change based on weather-related delay, provide and attach:

         a. applicable specified Weather Delay Reports, or, if none is specified, daily work logs that describe actual local weather conditions and their impact on progress.

         b. National Oceanic and Atmospheric Administration (NOAA) weather data, for corroboration.

         c. NOAA comparative data on normals, means, and extremes if such data or another weather baseline is not already provided in Contract Documents.

1.02 SIGNATURES for Change Order:

   A. Form shall be similar in format and content to Section 01 26 40, and signed by authorized representatives of each of the entities required by Conditions of the Contract.

   B. Normal procedure shall be that:

      1. Designer prepares and submits supporting documents to Owner.

      2. Owner produces and signs three (3) counterparts of form; transmits by fax, e-mail, or other means, informational copies to its Construction Representative, Designer, and Contractor; and forwards.

      3. Owner’s Construction Representative receives counterparts, and brings them to next Progress Meeting, unless urgency and opportunity make for a more timely execution.

      4. Designer and Contractor both sign all three (3) counterparts at Progress Meeting. Each retains a counterpart, and the Owner’s Construction Representative retains the third for the Owner.

END OF SECTION
PART 1 - GENERAL

1.01 EXTENSIONS OF CONTRACT TIME

A. If the basis exists for an extension of time in accordance with paragraph 8.3 of the Conditions, an extension of time on the basis of weather may be granted only for the number of Weather Delay Days in excess of the number of days listed as the Standard Baseline for that month.

1.02 STANDARD BASELINE FOR AVERAGE CLIMATIC RANGE

A. The Owner has reviewed weather data available from the National Oceanic and Atmospheric Administration and determined a Standard Baseline of average climatic range for the State of Tennessee.

B. Standard Baseline shall be regarded as the normal and anticipatable number of calendar days for each month during which construction activity shall be expected to be prevented and suspended by cause of adverse weather. Suspension of construction activity for the number of days each month as listed in the Standard Baseline is included in the Work and is not eligible for extension of Contract Time.

C. Standard Baseline is as follows:

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1.03 ADVERSE WEATHER and WEATHER DELAY DAYS

A. Adverse Weather is defined as the occurrence of one or more of the following conditions which prevents exterior construction activity or access to the site within twenty-four (24) hours:

   1. precipitation (rain, snow, or ice) in excess of one-tenth inch (0.10") liquid measure
   2. temperatures which do not rise above 32 degrees F by 10:00 a.m.
   3. temperatures which do not rise above that specified for the day's construction activity by 10:00 a.m., if any is specified
   4. sustained wind in excess of twenty-five (25) m.p.h.
   5. standing snow in excess of one inch (1.00")

B. Adverse Weather may include, if appropriate, "dry-out" or "mud" days:

   1. for rain days above the standard baseline;
   2. only if there is a hindrance to site access or sitework, such as excavation, backfill, and footings; and,
   3. at a rate no greater than 1 make-up day for each day or consecutive days of rain beyond the standard baseline that total 1.0 inch or more, liquid measure, unless specifically recommended otherwise by the Designer.

C. A Weather Delay Day may be counted if adverse weather prevents work on the project for fifty percent (50%) or more of the contractor's scheduled work day, including a weekend day or holiday if Contractor has scheduled construction activity that day.
1.04 DOCUMENTATION and SUBMITTALS

A. WEATHER DELAY REPORT:
   1. Use a copy of Section 01 26 25 as a Weather Delay Report, indicating for each calendar month the days on which construction activity affecting the critical path of the Work was prevented by weather conditions.
   2. In the column for the cause, indicate measurement of precipitation, temperature, wind, or other influencing factors.
   3. Describe the construction activity that was scheduled, on the critical path, and delayed.
   4. At the end of the month, add up the number of days delay, subtract the baseline number given in this Section, and show the resulting claimable days in excess of baseline.
   5. Submit a copy of the completed report with the next application for payment. Reports submitted with applications for payment do not constitute a claim or preliminary claim for extension of time.

B. When making a claim for a time extension based on weather delay(s):
   1. Submit a copy of all reports completed since the last month for which a time extension was previously claim, or the commencement of Work if no previous claim, through the last month for which delay is being claimed. Claims for time extension based upon weather delays are unjustified if a submitted report does not corroborate the claim or if no report was submitted when it was required with an application for payment.
   2. Submit daily jobsite work logs showing which and to what extent construction activities have been affected by weather on a monthly basis.
   3. Submit actual weather data to support claim for time extension obtained from nearest NOAA weather station or other independently verified source approved by Designer at beginning of project.
   4. Organize claim and documentation to facilitate evaluation on a basis of calendar month periods, and submit in accordance with the procedures for Claims established in Article 15 of the Conditions, and the applicable General Requirements.
   5. If an extension of the Contract Time is appropriate, it shall be implemented in accordance with the provisions of Article 7 of the Conditions, and the applicable General Requirements.

END OF SECTION
# SECTION 01 26 25
## WEATHER DELAY REPORT

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<th>Date</th>
<th>weather condition causing delay</th>
<th>Work scheduled on critical path for this day that was delayed</th>
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Total number of days this month with delay due to weather

Baseline number from Section 01 26 20

Total – Baseline = claimable days
The following changes in the Contract are hereby directed:

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

The original Contract Sum: ................................................................. $
Net Change previously authorized: ......................................................... $
The Contract Sum prior to this Modification: ............................................. $
This modification (increases / does not change / decreases) the Contract Sum: $
The new Contract sum, including this modification: ................................ $
This modification (increases / does not change / decreases) the Contract Time:....
The new Contract Time, including this modification: ................................ $
The last day of the Contract Time, including this modification: ..................

CONTRACTOR  DESIGNER  OWNER
Signed   Signed   Signed
Name & Name & Name &
Date   Date   Date   
For     For          

Form for Amendment, Change Order, or Directive
Jun 05 OFD 012640 Page 1 of 1
## SECTION 01 26 54
### FORM FOR PRICE SUMMARY

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<th>SBC Project Number:</th>
<th>Project Name:</th>
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Name of General contractor: ___________________________

<table>
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<th>Date Itemized:</th>
<th>Page of pages</th>
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<table>
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<th>Work by Subcontractors</th>
<th>Name of Subcontractor</th>
<th>Costs and Allowances</th>
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<th>General Contractor mark-up on Subtotal:</th>
<th>% =</th>
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Subtotal for General Contractor for work by subcontractors: 0.00

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<th>Work by General Contractor</th>
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<thead>
<tr>
<th>Subtotal (including Subcontractors and the General Contractor):</th>
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<th>Bond Premium:</th>
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Total: 0.00

Cells with red underline (if viewed in color) are for you to fill in. Others are protected.

Rounding off is permitted if rounding up for decreases and rounding down for increases. Math functions in XLS show rounded to nearest penny, but carry exact value for calculations. Let embedded math do its work.

This XLS spreadsheet is available on Owner's website, Designers' Manual, Bidding Documents, listed by its Section number and title.

Form for Price Summary
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Materials Subtotal: $0.00

Equipment Subtotal: $0.00

Labor Subtotal: $0.00

% Sales Tax = 0.00

% Burden = 0.00

Cost: 0.00

Cost: 0.00

Cost: 0.00

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

10% Overhead allowed on costs = $0.00

Subtotal of Costs + Overhead = $0.00

5% Profit allowed on Costs + Overhead = $0.00

Total for this change = $0.00

This XLS spreadsheet is available on Owner's website, Designers' Manual, Bidding Documents, listed by its Section number and title.
<table>
<thead>
<tr>
<th>Description</th>
<th>Period Cost</th>
<th>Period (Year, Month, Week, Day)</th>
<th>Cost Per Day</th>
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<td>Superintendent Vehicle</td>
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Subtotal of Costs: ____________________________

10% for Overhead: ____________________________

Subtotal with Overhead: ______________________

5% for Profit: ______________________________

Total per day: ________________________________

Cells with red underline (if viewed in color) are for you to fill in. Other cells are protected. Math functions show rounded to penny, but carry exact value for calculations. Let embedded math do its work.

Use "Year", "Month", "Week", or "Day" for period.

This XLS spreadsheet is available on the Owner's website, Designers' Manual, Bidding Documents, listed by its Section number and Title.
PART 1 - GENERAL

1.01 DEFINITION

A. The CM/GC-GMP Contingency and the Reserve Fund are defined in the CM/GC Master Contract Attachment 1 Scope of Services and Deliverables.

B. The CM/GC-GMP Reserve Fund is an accumulation from trades that were estimated at the time that the GMP was agreed upon and are later bid to complete the trade bidding. Trades that bid less than estimated add the difference to Reserve. Trades that bid more than estimated deduct the difference from Reserve. Once all estimated trades are bid and awarded, if there is a net negative Reserve, the amount is charged to the GMP Contingency, regardless whether the GMP Contingency has sufficient balance to cover the charge. The Reserve does not accumulate from savings through substitutions, reductions in Work, nor unused remainders of allowances; rather, such savings are to be returned to the Owner through an appropriate modification as soon as they occur.

1.02 CM/GC-GMP CONTINGENCY LOG

A. Maintain a Contingency Log on the specified form, showing for each item a sequence number, brief caption description, individual cost, the portion of that cost currently incurred for Total Completed and Stored to Date of applications for payment, and whether the item needs or has received concurrence required by 1.02.C. If there are Phases, make sequence numbering subordinate to each Phase, grouping the items by Phase, and provide a subtotal for each Phase.

B. Providing a copy of Log to Owner and Designer constitutes written advisement for items clearly fitting definition.

C. When providing an updated Log that contains items not clearly fitting Contingency definitions that have not been given written concurrence by Owner and Designer accepting the inclusion in the Contingency, identify such items and obtain written concurrence from Designer and Owner in the form of their initials upon a copy of the Log next to each such item.

1.03 RESERVE FUND LOG

A. Maintain a Reserve Fund Log on the specified form, showing for each estimated trade:
   1. the Name of the successfully bidding subcontractor engaged for the trade, once trade bidding is actually completed. Until then, while trade bidding is pending, leave the subcontractor blank;
   2. the Date for trade bidding, whether pending a future occurrence, or actually having occurred; or, when an exception to trade bidding has been authorized by the Owner, the date of authorization;
   3. the Description of the trade, and, if the amount of the trade is split between multiple line items in the schedule of values, the line items of the Schedule of Values that together account for the full amount of the trade;
   4. the Estimated Value of the trade as agreed;
   5. the Actual Price of the trade, once trade bidding has actually occurred and subcontracts awarded based upon bidding; and,
   6. the Effect on Reserve, which is the Estimated Value minus the Actual Price.

B. The Reserve Log spreadsheet calculates the Effect on Reserve once a Name is filled in. This formula is filled in for enough rows to fill most or all of the first page. If the Log requires further rows, copy the formula into the additional rows.

C. List the estimated trades in the order they are listed in the agreement and amendments, if any.

D. As trade bidding is completed for each trade, report the results, identifying the trade(s) procured, and providing an updated copy of the Reserve Log, bid tabulation, and a copy of the bids received.
E. Except as may be allowed according to paragraph F immediately below, if an estimated trade is not procured by bidding, it loses its status as an estimated trade and instead becomes a scope gap to be paid from the GMP Contingency. In this case, enter this in the Reserve Log with “scope gap” as the Subcontractor, the effective date as the Date, the Description unchanged, the Estimated Value unchanged, zero as the Actual Price, and the resulting increase Effect on Reserve.

F. Owner may authorize an exception to the requirement of bidding a trade when: the trade is a relatively small add to an existing subcontracted trade; or, if the trade is relatively small and impractical to procure through bidding; or, if the trade has been specified as proprietary or sole-source; or, if the trade is work that can only be provided by a local utility or government. In such exceptional cases, the CM/GC will provide an itemized cost for that trade using specification section 01 26 55; or, if a local utility or government, then whatever is their customary means of presenting their costs.

G. If Owner authorizes a transfer of Reserve into Contingency, enter this in the Reserve Log with the name of the Owner employee authorizing the transfer as the Subcontractor, the authorization date as the Date, “Owner authorized transfer” as the Description, zero as the Estimated Value, the amount of authorized transfer as the Actual Price, and the resulting decrease Effect on Reserve.

H. Attach current copy of Reserve Log to each counterpart of each Application for Payment.

1.04 EFFECT ON THE SCHEDULE OF VALUES
A. Include only values consistent with the current Contingency Log and Reserve Log. To the extent that 1.02.C requires concurrence for items, include only values consistent with concurrences received.

B. Include a single line item in the Schedule of Values for the Reserve Fund. If there are no phases in the Schedule of Values, include a single line item in the Schedule of Values for the CM/GC-GMP Contingency, and represent values as for other line items.

C. If there are Phases in the Schedule of Values:
   1. include an overall line item for the portion of the CM/GC-GMP contingency not included in a Phase;
   2. include also a line item in each Phase for its portion of the CM/GC-GMP contingency;
   3. initially, set CM/GC-GMP contingency values at full value for overall, and zero for each phase;
   4. as costs are assigned to CM/GC-GMP Contingency, to the extent costs are applicable within phases, increase scheduled value of applicable Phase, and reduce scheduled value of overall CM/GC-GMP contingency, so their sum remains constant; and,
   5. represent values for each CM/GC-GMP contingency line item as for other line items.

D. Include estimated trades as distinct line items in the Schedule of Values, initially showing these at their Estimated Value, later adjusting them to their Actual Price as the trade bidding is completed.

1.05 EFFECT ON APPLICATIONS FOR PAYMENT:
A total completed and stored to date for an estimated trade cannot be included in an application for payment until the procurement has been completed and the effect on Reserve shown in the Reserve Log.

1.06 EFFECT ON PROGRESS SCHEDULE AND PUBLIC ADVERTISEMENT:
A. In the Progress Schedule, show the bid dates for each estimated trade as also shown in the Reserve Log. In the Progress Schedule, include the period during which the trade will be released for solicitation of its trade bids.

B. Inform the Owner’s bidding coordinator specifically when each trade enters solicitation, and ensure that the bidding coordinator has posted the public advertisement for the suitable period approved by the Owner’s project manager.

END OF SECTION
<table>
<thead>
<tr>
<th>Date</th>
<th>Credit</th>
<th>Charge</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Date</td>
<td>Description</td>
<td>Estimated Value</td>
<td>Actual Price</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Current Reserve: 0.00
SECTION 01 29 54
RETAINAGE ESCROW INITIATION

PART 1 - GENERAL

1.01 Basic Requirements

A. Retainage escrow requirements are mandated by Chapter No. 340 House Bill No. 966 Public Acts of 1985 which was passed by the Tennessee General Assembly.

B. Conditions of Contract, in accordance with State law, require retainage to be deposited into an interest-bearing escrow account if the Contract Sum $500,000 or greater. Compliance is mandatory and cannot be waived.

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

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

1.03 Getting Started

A. Shortly after award of Contract, the Tennessee Department of Finance and Administration (F&A) will send the Contractor its latest information for starting the account. This information typically includes:
   1. procedural guide
   2. forms, including the basic application, colloquially referred to as “Form A”.
   3. list of banks that currently have agreements with the State to host retainage escrow accounts

B. Getting help
   1. The instructions from F&A will include a name and phone number to call for help:
      a. If the Contractor needs help completing Form A.
      b. If the Contractor plans to use a lending institution that does not have a current agreement with the State for hosting retainage escrow.
   2. At the time this standard specification is written (see bottom left of page) the contact person for help in setting up new escrow accounts and completing Form A is Mary Mansour at (615)741-1317.

C. To avoid delays in setting up the escrow, and possible delays in payment, do not wait to be contacted by F&A as described above. Instead, if the Contract Sum is $500,000 or greater, as soon as the Contract is awarded, take the Form A that is page 2 of this Section, get it filled out and executed with the escrow bank, and have the bank send the original wet-signature Form to

   ATTN: Mary Mansour
   Tennessee Department of Finance and Administration
   Office of Business and Finance
   Suite 2000 William R. Snodgrass Tennessee Tower
   312 Rosa L. Parks Avenue
   Nashville TN 37243-0294

1.04 A sample of Form A is provided on page 2 of this Section. Otherwise, this is the …

END OF SECTION
FORM A

APPLICATION FOR THE SUBSTITUTION OF SECURITIES FOR ALL AMOUNTS RETAINED ON STATE BUILDING COMMISSION CONSTRUCTION CONTRACTS

Date: ________________________________

RE: Contract Number: __________________________

Project No.: __________________________

Location: __________________________

Dear State Building Commission:

Pursuant to the provisions of Tennessee Code Annotated, Sections 12-4-108,

hereby requests that whenever payment for which certain amounts are retained by the State Building Commission as determined by the subject construction contract, the amount so retained be substituted for approved securities, as designated by the Tennessee State Treasurer.

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

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

Very truly yours,

(Signature of Authorized Representative of Contractor) (Title)

ACCEPTED:

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

CONTACT PERSON (BANK) __________________________

PHONE NUMBER __________________________

PLEASE PRINT
PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Phases are normally set forth in the Agreement and in the Summary of Work specification, normally from 01 10 00 to 01 10 19, but may differ in this Project Manual.

B. Applications for Payment and the final statement of accounting are normally specified in sections from 01 29 00 to 01 29 99, such as OFD standard Section 01 29 76, but may differ in this Project Manual.

C. Allowances are normally specified in sections from 01 21 00 to 01 21 99, such as OFD standard sections 01 21 13 and 01 21 15. Allowances associated with Unit Prices are normally in sections from 01 22 00 to 01 22 99, such as OFD standard sections 01 22 13 and 01 22 15. The arrangement of sections may differ in this Project Manual.

1.02 FORM and APPROVAL

A. The form for schedule of values shall be AIA Document G703 Continuation Sheet.

B. If objected to by Designer, revise and resubmit to Designer's satisfaction prior to submitting application for payment. If during construction, a line item's total completed and stored to date for payment purposes exceeds or is anticipated to exceed allocations, revise and resubmit a schedule of values such that no values of completed work exceed their allocations.

1.03 ALLOCATION OF VALUES

A. If the Work is divided into defined portions ("Phases"), intended to have distinct commencement, duration, or completion requirements, divide the allocation to correspond to the Phases, providing a sub-total for each Phase; then within each Phase, subdivide the allocations as specified in the following paragraphs.

B. Provide at least these three line items to account for General Requirements:
   1. Mobilization, staging, and general start-up costs.
   2. Construction administration and temporary facilities, prorated over the course of the project.
   3. Maintenance of Record Documents, prorated over the course of the project.

C. If sitework is included, other than minor sitework incidental to a building or major structure, include sitework in single line item or group of line items. Within the group, categorize site utilities, roads and parking, and appurtenances according to general type and physical separation. If allowances are stipulated in the Work relating to sitework, provide a line item for each such allowance, including quantity allowances associated with Unit Prices.

D. For each involved building or major structure:
   1. If allowances are stipulated in the Work, provide a line item in the Schedule of Values for each allowance, including quantity allowances associated with Unit Prices.
   2. If the Contract is a CM/GC contract based on a Guaranteed Maximum Price (GMP) with estimated trades identified as a part of the GMP, provide a distinct line item for each estimated trade.
   3. Categorize by major trades or units of work corresponding to the current Progress Schedule, and relate to the Divisions and Sections of the Specifications.
   4. Further subdivide as desired, but maintain a distinct and identifiable correspondence to this allocation.

E. Account for Modifications by incorporating them into the appropriate allocations, or with a line item for each, until incorporating each into the appropriate allocations for the final statement of accounting.

END OF SECTION
PART 1 - GENERAL

1.01 SUBMITTAL:

A. In each application for payment, according to its context, provide:

<table>
<thead>
<tr>
<th>Counterpart or Copy</th>
<th>Progress Payment</th>
<th>Reducing Retainage upon SC</th>
<th>Final Payment</th>
<th>Document</th>
</tr>
</thead>
<tbody>
<tr>
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<td>YES</td>
<td>G702 Application</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>G703 Continuation</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Final Accounting</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>Contingency &amp; Reserve Logs (if CM/GC)</td>
</tr>
<tr>
<td>copy</td>
<td>if any</td>
<td>if any</td>
<td>no</td>
<td>Off-Site Stored Materials documents</td>
</tr>
<tr>
<td>counterpart</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Affidavit of Payment</td>
</tr>
<tr>
<td>counterpart</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Insurance Certificate</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Statement of continuing insurability</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>if any</td>
<td>if any</td>
<td>U&amp;O permit</td>
</tr>
<tr>
<td>copy</td>
<td>yes</td>
<td>yes</td>
<td>if any</td>
<td>Data Binder Receipt(s)</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Roof Warranty or warranties</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Report of Subcontractors and Suppliers</td>
</tr>
<tr>
<td>copy</td>
<td>yes</td>
<td>if any</td>
<td>if any</td>
<td>Visitor Log</td>
</tr>
<tr>
<td>copy</td>
<td>yes</td>
<td>if any</td>
<td>if any</td>
<td>Weather Delay Report</td>
</tr>
<tr>
<td>copy</td>
<td>yes</td>
<td>no</td>
<td>YES</td>
<td>Progress Schedule</td>
</tr>
<tr>
<td>copy</td>
<td>yes</td>
<td>YES</td>
<td>YES</td>
<td>Submittal Log</td>
</tr>
</tbody>
</table>

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

C. Counterpart documents shall be original instruments with wet signatures and embossed or wet-stamped seals, in each set of application documents.

D. Provide a draft submission, including attachments, as a PDF attached to an email, to Designer and to the Owner’s construction representative three (3) days prior to actual submittal.

E. Provide actual submission of five (5) sets of the application documents to the Designer at Progress Meeting, Substantial Completion inspection meeting, or final inspection meeting. If submitted outside of these meetings, provide conveyance of application to Designer, from Designer to Owner’s construction representative, and from Owner’s construction representative to Owner’s central office.
1.02 INCLUSIONS AND CALCULATIONS:

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

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

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

D. Calculation of Retainage and amounts withheld:
   1. Credit for completed work and stored materials, and deductions for incomplete work, comprise the “Total Completed and Stored to Date”. The “Total Completed and Stored to Date” shall not include the value of Punch List items that remain incomplete after Substantial Completion.
   2. Retainage is calculated as a percentage of “Total Completed and Stored to Date”: 5% prior to Substantial Completion; 2% after Substantial Completion; then, none at final payment. In the continuation sheets, showing retainage at individual line items is not required and is discouraged, as it promotes rounding errors. Retainage should only be shown at Phase sub-totals, if Phases exist, and when retainage rates vary between phases.
   3. Other amounts withheld (i.e., potential liquidated damages or in response to subcontractor claims of non-payment) can be added to the continuation sheet and deducted from the Total Completed and Stored to Date, or can be deducted from the resulting Current Payment Due after retainage and prior payments are accounted.

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

1.03 FORMS, FORMAT, and CONTENT:

A. G702 Application: Use AIA Document G702 Application and Certificate for Payment
   1. For Project identification, include the Owner’s project number featured prominently, institution name, and work name, which is normally the Project title shown in the Agreement.
   2. Provide a unique, sequential application number.
   3. Include the Contractor’s address exactly as provided in the ACH Form.
   4. Show the County where the Work is located, normally where AIA captions “Contract for”.

B. G703 Continuation: Use AIA Document G703 Continuation Sheet itemized with the line items and values of the Schedule of Values accepted by Designer, and values and percentages for each line item. If there are Phases, include a sub-total for each Phase as well as a grand total.

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

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

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

F. Affidavit of Payment of Debts and Claims: Provide counterpart using AIA Document G706, when requesting final payment for the Work or reduction of retainage to zero for any portion of the Work.
G. Consent of Surety:
   1. If seeking reduction in retainage prior to Final Payment for the entire Work, or final payment on only a portion of the Work, provide counterpart using AIA Document G707A Consent of Surety to Reduction in Retainage, or a similarly formed letter.
   2. If seeking Final Payment, provide counterpart using AIA Document G707 Consent of Surety Company to Final Payment, or a similarly formed letter.
   3. If Contractor has listed exceptions in the Affidavit of Payment, Surety’s consent shall acknowledge such exceptions.
   4. If Contract is not bonded, Consent of Surety is not required, and Owner will instead advertise a public notice of settlement, and wait 30 days for responses, before accepting the application.
   5. Provide counterpart of Power of Attorney with Consent of Surety.

H. Insurance Certificate: If seeking final payment, provide certificate of insurance for products and completed operations as required by Conditions of the Contract sections 9.10.2(2) and 11.1.2.1.c.

I. Statement of continuing insurability: if seeking final payment, a letter written to the effect required by Conditions of the Contract section 9.10.2(3).

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

K. Data Binder Receipt:
   1. with first application following substantial completion, provide copy of document identifying to whom Contractor delivered the Operating and Maintenance Data Binders.
   2. with application for final payment, provide copy of document identifying to whom Contractor delivered Project Data Binders

L. Roof Warranty or warranties, if any required on the Owner’s Section 07 50 35 standard form.

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

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

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

P. Progress Schedule, updated and current, indicating progress through the period covered by application and scheduled progress through completion of Work. This is not required with the request for final payment.

Q. Shop Drawing Log for entire project through the period covered by application. If there has been no shop drawing log activity since a previous copy was submitted with a previous application, a single page can be substituted saying so and identifying which pay request had the latest up-to-date log. If a log is long and has many of its early pages unchanged since a previous copy was submitted with a previous application, a single page can be substituted for the earlier unchanged pages saying so and identifying which pay request had the latest copy of those pages.

1.04 CERTIFICATION

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

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

END OF SECTION
SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures; Coordination Drawings.
   2. Administrative and supervisory personnel.
   3. Requests for Interpretation (RFIs).

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

1.02 RELATED SECTIONS

A. Project Meetings: Section 01 31 19.

1.03 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS

A. Key Personnel Names: Within 15 (calendar) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
   1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.05 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors for maximum accessibility for required maintenance, service and repair.
   3. Make adequate provisions for items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

B. 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. Prepare similar memoranda for Owner and separate contractors 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.
8. Startup and adjustment of systems.
9. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure operations are carried out with consideration given to conservation of energy, water and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.06 COORDINATION DRAWINGS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
   a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
   b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   c. Indicate required installation sequences and for anticipated replacement of components during the life of the installation.
   d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
   e. Indicate required installation sequences.
   f. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with
submitted equipment and minimum clearance requirements. Provide sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

g. Complete sufficient demolition to confirm dimensions and clearances before submitting drawings.

h. Preparation of coordination drawings of the Work specified in divisions 21 through 28 shall include the following procedure:
   1) Ductwork shop drawings shall be prepared indicating bottom of duct elevations.
   2) A reproducible of these drawings shall be given to the subcontractors responsible for Division 21 through Division 28 work, and they shall each review the drawing for conflicts with their work.
   3) Contractor shall hold coordination meetings at which coordination conflicts will be resolved. Contractor to document agreed to coordination resolution.
   4) Installation of work may not proceed without resolution of coordination conflicts by the Contractor. Work not installed in accordance with the agreed to coordination documents is subject to replacement if conflicts remain, with related costs borne by the Contractor.

2. Sheet Size (inches): At least 8-1/2 by 11, but no larger than 30 by 42.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
   1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
   2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
   3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
   4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
   5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
   6. Mechanical and Plumbing Work: Show the following:
      a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
      b. Show plumbing lines. Notate code required slope elevations.
      c. Dimensions of major components: dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
      d. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger and racks of smaller conduit are required.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads and inspected test valve drains.

9. Review: Consultant will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Consultant determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Consultant will so inform Contractor, who shall make changes as directed and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings or program and system as approved by Architect.
   2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
   3. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
      a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
      a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      b. Execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.07 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work. Include special personnel required for coordination of operations with other contractors.

1.08 REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
   1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
   1. Project name.
   2. Date.
   3. Name of Contractor.
   5. RFI number, numbered sequentially.
   7. Drawing number and detail references, as appropriate.
   8. Field dimensions and conditions, as appropriate.
   9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or Sum, Contractor shall state impact in the RFI.
   10. Contractor's signature.
   11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
       a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Hard-Copy RFIs: Identify each page of attachments with the RFI number and sequential page number.

D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow 15 days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for approval of Contractor's means and methods.
   d. Requests for coordination information already indicated in the Contract Documents.
   e. Requests for adjustments in the Contract Time or Contract Sum.
   f. Requests for interpretation of Architect's actions on submittals.
   g. Incomplete RFIs or RFIs with numerous errors.

2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.

3. Architect's action on RFIs that may result in a change to the Contract Time or Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within 7 days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.09 PREINSTALLATION CONFERENCE

A. Conduct a preinstallation conference onsite before each construction activity that requires coordination with other trades; were required in specification sections.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Review of mockups.
   i. Possible conflicts.
   j. Compatibility problems.
   k. Time schedules.
   l. Weather limitations.
   m. Manufacturer's written recommendations.
   n. Warranty requirements.
   o. Compatibility of materials.
   p. Acceptability of substrates.
   q. Temporary facilities and controls.
   r. Space and access limitations.
   s. Regulations of authorities having jurisdiction.
   t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

PART 2 - PRODUCTS
Not Used

PART 3 – EXECUTION
Not Used

END OF SECTION
SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.01 SCHEDULING AND ATTENDANCE

A. The Designer, in cooperation with the Owner and the Contractor, will schedule and administer a Pre-
Construction Conference, periodic Progress Meetings, and other specially called or required meetings.

B. Representatives of the Owner and the Designer will attend.

C. Representatives of the Contractor, subcontractors, and suppliers attending meetings shall be qualified
and authorized to act on behalf of the entity each represents. In the case of the Contractor, the
representative shall be one who is authorized to sign change orders.

1.02 PRE-CONSTRUCTION CONFERENCE

A. A Pre-Construction Conference will be scheduled and conducted at the project site prior to the issuance
of the Notice to Proceed.

B. The Pre-Construction Conference shall be attended by the Contractor's:
   1. (Office) Job Manager
   2. (Field) Job Superintendent
   3. Major subcontractors' representatives
   4. Major suppliers' representatives
   5. Others, as desired.

C. The Pre-Construction Conference is intended to be an opportunity for the Contractor to review
administrative, procedural, and temporary facilities requirements of the Contract Documents, and to ask
questions concerning the Work.

1.03 PROGRESS MEETINGS

A. Progress Meetings will be scheduled and conducted at the project site, typically twice-monthly, or when
deemed advisable by the Designer.

B. Progress Meetings shall be attended by the Contractor's:
   1. (Office) Job Manager
   2. (Field) Job Superintendent
   3. Subcontractors' representatives, as befits the agenda
   4. Suppliers' representatives, as befits the agenda
   5. Others, as appropriate.

C. Progress Meetings are intended to include a monthly opportunity for the Contractor to submit
applications for payment, signing of change orders by Designer and Contractor, a general review of the
progress of the Work, and identifying and mitigating impediments to timely completion.

D. Progress Meetings will be scheduled and conducted until final completion.

END OF SECTION
PART 1 - GENERAL

1.01 SUBMITTALS LOG

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

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

1.02 VISITOR LOG

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

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

END OF SECTION
PART 1 - GENERAL

1.01 INITIAL PROGRESS SCHEDULE

A. Submit within 21 days of award of the Contract, and not later than the date of submission of the first application for payment. Clearly identify the Project on the schedule.

B. Outline the orderly progress of the Work as planned from the Notice to Proceed through Substantial Completion on the contractually required date. Categorize the Work by Phase (if Phases are specified), major work area, and distinct trade or team, and divide into individual activities of one month or less duration each. Provide an identifiable relationship to the schedule of values. Identify projected monthly progress, points of 50% completion, Substantial Completion, and final completion, and other major milestones. If included in the Work, Commissioning activities and Storm Water Pollution protection Plan (SWPPP) activities shall be among those major milestones. If planting or landscaping that is seasonally sensitive is included in the Work, show that portion of Work distinctly during a seasonally appropriate time.

C. A bar chart or critical path method is acceptable, or other method which is approved by the Designer. Since requests and claims for extension of time require demonstrating effect upon the critical path of Work, a critical path method schedule is recommended, and may be required as supporting documentation to prove validity of a requested or claimed time extensions.

1.02 SUBMITTALS SCHEDULE

A. Submit with the initial Progress Schedule. Clearly identify the Project, and format in a manner similar to the initial progress schedule, utilizing the same method, or make a part of the initial Progress Schedule.

B. Identify submittals to be made. Show date for submission and date by which Designer should respond, allowing sufficient time for review.

C. Designer may require revision of schedule if times allotted for review are insufficient.

1.03 UPDATED PROGRESS SCHEDULE

A. Submit a copy attached to each counterpart of applications for payment.

B. Clearly identify the Project. Format in a manner similar to the initial progress schedule, utilizing the same method.

C. Indicate:
   1. Work as initially scheduled.
   2. Actual progress through the period covered by the current application for payment.
   3. Planned progress through Substantial Completion, including extensions of time made by change order or construction change directive.

D. If actual progress falls behind projections, show how the backlog is to be made up so that the Work will be completed on time.

END OF SECTION
SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.02 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

B. Informational Submittals: Written information not requiring Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.03 GENERAL REQUIREMENTS

A. Requirements of this Section are in addition to those of the General Conditions.

B. This Section includes procedures for processing:
   1. Shop drawings.
   2. Product data.
   3. Samples.
   4. Certificates of compliance.
   5. Reports.
   7. Design data.
   8. Other submittals listed.

C. Submittals as approved do not constitute a change order.

D. 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 submittal types for related parts of the Work so processing will not be delayed because of need to review concurrently for coordination. A/E reserves the right to withhold action on concurrent coordination submittals until related submittals are received.

E. Submittals Schedule: See Section 01 32 15, for submittals and time requirements for scheduled performance of related construction activities.
   1. Submittals received prior to receipt of the initial Submittals Schedule will be rejected.
   2. Submittals received prior to the time they are indicated on the Submittal Schedule to be submitted will be rejected.
F. Make all submittals far enough in advance of scheduled dates for installation to provide sufficient time for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.

1. Delays caused by the tardiness of the Contractor in preparing and forwarding submittals will not be an acceptable basis for an extension of the Contract completion date or for consideration of alternate products which do not meet the specified requirements of this Project Manual.

2. Initial Review: Allow 7 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.

3. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

4. Resubmittal Review: Allow 7 days for review of each resubmittal.

5. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is necessary, allow 10 days for initial review of each submittal.

6. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to consultants, allow 10 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

G. Identification: Place a permanent label or title block on each submittal for ID.

1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space 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 unique identifier, including revision identifier.
      1) Submittal number shall use Specification Section number.
   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.

H. Notify Architect in writing at time of submittal of deviations from the requirements of the Contract Documents. In addition, highlight, encircle, or otherwise specifically identify deviations.

I. 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.

J. Resubmittals: When Architect requires that a submittal be resubmitted, comply with requirements of this section; Identify changes made since previous submittal.

K. 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.

L. Electronic Files: At Contractor's written request, copies of Architect's electronic files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Execute Electronic File Transfer Agreement provided by the Architect to obtain files.
   2. The electronic files are provided for the Contractor's convenience and their use will be at the Contractors risk.
      a. There are no assurances that the information in the electronic files is current. All dimensions must be field-verified.

1.04 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Section.

B. Product Data
   1. Submit only pages which are pertinent.
      a. Mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number.
      b. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.
   2. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
   3. Stamp and sign each set of manufacturer's product data before submitting
4. Number of Copies Required: Submit two paper copies of Product Data, and in portable data file (.pdf) format, unless otherwise indicated. When submitting for Concurrent Consultant Review, submit two copies to Consultant and one copy to Architect. Architect will return one copy. Mark up and retain returned copy as a Project Record Document.
   a. Reproduction and cost of reproduction of processed Product Data for distribution to concerned parties is Contractor’s responsibility.

C. Shop Drawings
   1. Reproduction of any portion of the Contract Documents for use as submittals for Shop Drawings is not acceptable.
   2. Submit Shop Drawings in a clear and thorough manner.
      a. Title each drawing with Project name.
      b. Identify each element of drawings by reference to sheet number and detail, schedule, or room number of Contract Documents.
   3. Identify the following:
      a. Requirements of the individual section of Project Manual.
      b. Field measurements.
      c. Field construction criteria.
      d. Relation to adjacent or critical features of the Work or products.
      e. Conformance of submittal with Contract Document requirements.
   4. Each sheet of Shop Drawings shall be stamped and signed by Contractor before submitting to Architect. Certify compliance with requirements of Contract Documents.
   5. Review by the Architect shall not relieve Contractor from his responsibility in preparing and submitting proper Shop Drawings in accordance with his current obligations.
   6. All submissions which, in the opinion of the Architect are incomplete, contain errors or have not been checked or only superficially checked, will be returned unchecked by the Architect for resubmission.
   7. Fabrication of products or start of work before required Shop Drawings are approved by A/E and returned to Contractor shall be at Contractor’s risk.
   8. Number of Copies Required: Submit two paper copies of each submittal, and in portable data file (.pdf) format, unless indicated otherwise. When submitting for Concurrent Consultant Review, submit two copies to Consultant and one copy to Architect. Architect will return one copy. Mark up and retain one returned copy as a Project Record Drawing.
      a. Reproduction / cost of reproduction of processed shop drawings for distribution to concerned parties is Contractor’s responsibility.
      b. This procedure is to be followed for each submission of a drawing or group of drawings until they are finally approved by the Architect.

D. Office Samples: Submit Samples for review of kind, color, pattern and texture to check these characteristics with other elements and to compare 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. 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 Required: Submit two sets of Samples. Architect will retain one Sample set; the other will be returned.
      1) Submit a single Sample where workmanship, assembly details, 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 two sets of paired units that show approximate limits of variations.

E. Mock-Up Samples: Where samples are specified in the individual sections for use in constructing mock-ups, comply with requirements for "Office Samples", and process transmittal forms for mock-ups to provide a record of activity.

F. Submittals Schedule: See Section 01 32 15, Construction Schedules.

G. Schedule of Values and Application for Payment: Outlined in the Agreement.

1.05 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
   1. Number of Copies: Submit one copy of each submittal, unless otherwise indicated. Architect will not return copy.
   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: None required due to project scope.
B. Coordination Drawings: See Section 01 31 00, Coordination Drawings.

C. Contractor's Construction Schedule: See Section 01 32 15, Progress Schedules and Reports.

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. 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.

N. 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.

O. 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.

P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment; as required for the project close-out, Operating and Maintenance Data.

Q. 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 / version of software, if any, used for calculations. Include page numbers.

R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating product or equipment. Include name of product and name, address and telephone number of MFR. 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.

S. 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.
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, except as required in "Action Submittals" Article.

1.06 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit two copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional. When submitting for Concurrent Consultant Review, submit two copies to Consultant and one copy to Architect.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 2 PRODUCTS  Not Applicable

PART 3 EXECUTION

3.01 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.

3.02 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. Reference the General Conditions for Architect's review responsibilities. Approval of a specific item does not indicate approval of an assembly of which the item is a component. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
1. REVIEWED
2. APPROVED
3. APPROVED AS CORRECTED
4. REVISE AND RESUBMIT
5. REJECTED.

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
SECTION 01 35 13

SPECIAL PROJECT PROCEDURES

PART 1  GENERAL

1.01  SUMMARY

A. The existing building will remain partially occupied within the construction site. The adjacent buildings, roads and parking areas will remain occupied and fully functional during construction. No interruption of services for all buildings will be permitted. Consult and carefully schedule with the Owner to achieve this aim.

1.02  PROCEDURES WITHIN SITE AREA ON BUILDING SITE

A. Performance of Work
   1. The adjacent properties will be occupied throughout the entire course of construction. As such, contractors and their personnel are restricted to the areas of and access to the building site only.
   2. Access must be maintained to public streets and all adjacent areas that border the site in a safe and sanitary manner.

B. Conduct: Contractor and workmen are to be quiet and non-offensive. Radios are prohibited. No interaction with the public will be allowed.

C. Dress Code
   1. Required Apparel: Shirt, long pants, sturdy work boots appropriate for work activities; all suitably clean.
   2. Not Permitted: Offensive graphics or messages on clothing, short pants, tank tops, sandals, open toed shoes, bare torso, bare feet.

D. Areas under construction shall be separated from occupied areas by suitable barriers. See Section 01 50 00 for additional requirements. In no instances may public streets be blocked or the clear lane width reduced unless approval has been granted by all Authorities Having Jurisdiction and permits have been issued at least 30 calendar days prior to the need of the occurrence.

E. No utilities or services may be interrupted without full consent of and prior scheduling with the Utility Companies and the adjacent properties affected.

1.03  UTILITY SHUT-DOWN

A. Advance notice required: Contractor to request, a minimum 30 days in advance, the Owner's permission to shut down electric power, gases or systems to their properties. Request to be in writing and indicate the area(s) affected, time and date shut-down requested to commence, and anticipated duration of shut-down. Approved time and date may not be as requested, will be at times least disruptive to Owners, and may be during non-normal working hours.
   1. Disclaimer: No additional payments will be allowed due to Contractor's difficulties due to being held to the above restrictions.
1.04  NOISE AND SAFETY

A. Prohibited Methods: Prohibited methods and materials include, but not limited to:
   1. Use of explosives.
   2. Use of jack hammers or similar equipment which can cause structure-borne vibration detrimental to the use of the occupied facilities.

B. Construction Working Hours: All Work shall occur between the **hours of 7am and 6pm; unless otherwise dictated in the Contract.** Construction noise limited to Normal Working Hours.

1.05  EXISTING FACILITIES

A. The primary construction zone is defined in the Construction Managers phasing documents.

B. Exterior doors should be secured at all times, unless being used for construction purposes. The CM/GC is responsible for security.

1.06  NO SMOKING POLICY

A. Smoking is prohibited on site, including electronic cigarettes.

1.07  SITE AND BUILDING ACCESS

A. Existing driveways and entrances which serve the premises must be maintained. They must be available to the Owner and public at all times. Do not use these areas for parking or storage of materials.
   1. Do not unreasonably encumber the site with materials or equipment. Confine stock piling of materials and location of storage trailers to the areas indicated on the drawings or as directed by the Architect.
   2. Schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on the site.

END OF SECTION
PART 1  GENERAL

1.01  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-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 quality-control procedures that facilitate compliance with the Contract Document requirements.

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

1.02  RELATED SECTIONS

A. Cutting and Patching (for repair and restoration of construction disturbed by testing and inspecting activities): Section 01 73 29.

B. Specific test and inspection requirements: Divisions 02 through 49 Sections.

1.03  DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.

C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. 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. Mockups establish the standard by which the Work will be judged. Refer to article 1.07 of this section for additional requirements regarding mockups in paragraphs I, J, K & L

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on the project site, consisting of multiple products, assemblies and subassemblies.

2. Panel(s) to reflect all exterior envelope assembly components; and is to be reviewed by the Commissioning Agent prior to start of building Work.
D. 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.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards. [see 1.06.G this section]

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

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

I. Installer/Applicator/Erector: Contractor or entity engaged by GC as employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application and similar operations. Using terms 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 tradespeople of the corresponding generic name.

J. 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.

1.04 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

B. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.05 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer 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.
1.06 SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
   1. Indicate manufacturer and model number of individual components.
   2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

D. 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. Ambient 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 re-inspection.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.07 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 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.

H. 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.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
      e. Build laboratory mockups at testing facility using personnel, products and methods of construction indicated for the completed Work.
      f. When testing is complete, remove test specimens, assemblies, mockups and laboratory mockups; do not reuse on Project.
   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups 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. Allow 7 days for initial review/re-review of each mockup.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work. Cover mock-ups to protect them from deterioration and weathering.
6. Demolish / remove mockups when directed, unless otherwise indicated.

K. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings or in areas specified. Coordinate installation of exterior envelope materials and products for which mockups are required in individual specification sections, along with supporting materials.

L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections in Divisions 02 through 49.

1.08 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged.
2. Payment for these services will be made by the Owner.
3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

   1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   3. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect, Engineer, Construction Manager, and Owner with copy to Contractor and to authorities having jurisdiction.
   4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
   5. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field-curing of test samples.
   5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   6. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.09 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to
conduct special tests and inspections required by IBC as the responsibility of the Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, 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 reinspecting corrected work.

PART 2  PRODUCTS (Not Used)

PART 3  EXECUTION

3.01 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.

3.01 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Comply with requirements of Section 01 73 29, 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 OF SECTION
SECTION 01 41 13

FIRE RESISTANCE RATINGS REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY
   A. Requirements of this Section apply to the Work of all other Sections.

1.02 STANDARDS
   A. Standards, codes and regulations published by Manufacturer's Associations, governmental agencies, referenced fire resistance rating and other regulatory authorities form a part of these Specifications as minimum requirements.
   B. Where differences occur between the Contract Documents and such standards, the most restrictive requirement shall apply.
   C. Supply all materials and perform all work in accordance with the fire rating assembly and installation procedures, and in conformance with published trade and manufacturer's association standards, unless specifically noted otherwise.

1.03 REFERENCES
   A. American Society for Testing and Materials (ASTM)
   B. National Fire Protection Association (NFPA)
   C. Underwriters' Laboratories (UL)

PART 2 MATERIALS

2.01 MATERIALS AND PRODUCTS
   A. See individual assembly specifications for materials and products used in fire ratings assembly.
   B. References and standards listed in the individual fire rated assembly specification sections apply to the work of this section.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Refer to drawings for locations, extent and fire rated assembly to be used. See individual fire rating assembly specification sections for installation requirements and procedures of materials and products used.
B. General: Use materials, fabrication, construction personnel and installation methods identical with those indicated and planned for the final Work.

END OF SECTION
### PART 1 - GENERAL

#### 1.01 CODES AND REGULATIONS

**A.** The Regulatory Requirements used for Tennessee Board of Regents projects are listed below as a convenience and may not be inclusive of all that apply. Others may also apply. Comply with all pertinent codes, standards, regulations and laws.

<table>
<thead>
<tr>
<th>Document</th>
<th>Source</th>
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<tbody>
<tr>
<td>2. NFPA 101 Life Safety Code, 2012 No provision of the preceding cited publications shall be adopted that conflicts: The installation and service standards of portable fire extinguishers and fixed fire extinguisher systems in Tenn. Comp. R. &amp; Regs. 0780-02-14-.02; and, The standards for engaging in the liquefied petroleum gas business in Tenn. Comp. R. &amp; Regs. 0780-02-17-.02. Paragraph (1) of this rule shall not be construed as adopting any provision of the cited publications which establishes: and optional or recommended, rather than mandatory, standard or practice; or, any agency, procedure, fees or penalties for administration or enforcement purposes inconsistent with the statute or rules. 2008 National Electrical Code</td>
<td>National Fire Protection Association 1 Batterymarch Park Quincy, Massachusetts 02169-7471 (800) 344-3555</td>
</tr>
<tr>
<td>3. 2007 Tennessee Elevator Safety Board Rules Chapter 0800-3-4 Elevators, Dumbwaiters, Escalators, and other Lifts 2007 Board of Boiler Rules Chapter 0800-3-3 Boiler Inspections</td>
<td>Tn. Dept. of Labor and Workforce Development Div. of Boiler, Elevator &amp; Amusement Device Inspection 220 French Landing Drive Nashville, TN 37243-1006 (615) 741-2123</td>
</tr>
<tr>
<td>4. ASHRAE standard 62.1-2013 Ventilation for Acceptable Indoor Air Quality</td>
<td>American Society of Heating, Refrigerating &amp; Air Conditioning Engineers 1791 Tullie Circle NE Atlanta, Georgia 30329 (404) 636-8400</td>
</tr>
<tr>
<td>5. Tennessee Chapters 0780-2-1, Electrical Installations 0780-2-2, Codes &amp; Standards 0780-2-3, Plan &amp; Spec Review 0780-2-18, Equitable Restrooms</td>
<td>Department of Commerce and Insurance Fire Prevention Division Codes Enforcement Section 500 James Robertson Parkway Nashville, Tennessee 37243-1162 (615) 741-2981</td>
</tr>
</tbody>
</table>
### Basic Regulatory Requirements

#### 6. ADA Title II, State and local government facilities must follow the requirements of the 2010 standards, including both the Title II regulations at 28 CFR 35.151 and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. In the few places where requirements between the two differ, the requirements of 28 CFR 35.151 prevail. The compliance date is March 15, 2012, for all newly constructed or altered State and local government facilities permitted after this date.

ADA Title III, Public accommodations and commercial facilities must follow the requirements of the 2010 standards, including both the Title III regulations at 28 CFR part 36, subpart D; and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. In the few places where requirements between the two differ, the requirements of 28 CFR part 36, subpart D prevail. The compliance date is March 15, 2012, for all newly constructed or altered facilities permitted after this date.

#### 7. TDEC Division of Water Pollution Control

Tennessee water quality control act of 1977 (TCA 69-3-101)

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

**Tennessee Department of Environment and Conservation Division of Water Pollution Control**
401 Church Street
Nashville, TN 37243
(615) 532-0625
PART 1 - GENERAL

1.01 CONTRACTOR'S RESPONSIBILITIES

A. Employ and pay for the services of an independent testing laboratory, approved by the Designer, to perform specified services and testing. Employment of laboratory does not relieve Contractor's obligations to perform the Work of the Contract.

B. Coordinate and pay for inspections and testing required by law, ordinance, rules, regulations, orders, or approvals of public authorities as required by the Contract Documents.
   1. Furnish copies of Products Test reports as required.
   2. Furnish incidental labor and facilities to facilitate inspections and tests and for storage and curing of test samples.
   3. Notify the lab sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
   4. Make arrangements with lab and pay for additional samples and tests required for Contractor's convenience.

1.02 TESTING LABORATORY

A. Qualifications:
   1. Meet "Recommended Requirements for Independent Laboratory Qualification", published by the American Council of Independent Laboratories, and Basic requirements of ASTM E 329 "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction".
   2. Be authorized to operate in the State of Tennessee.
   3. Submit copies to the Designer of the report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during the most recent tour of inspection with the memorandum of remedies of any deficiencies reported by the inspection.

B. Duties and limitations of authority:
   1. Perform specified inspections, sampling, and testing of materials and methods of construction and promptly submit five copies of the written report of each test and inspection to the Designer.
   2. Laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, approve or accept portions of the Work, or perform duties of the Contractor.

END OF SECTION
PART 1  GENERAL

1.01  GENERAL REQUIREMENTS

A. Special Inspections and Structural Testing shall be in accordance with Chapter 17 of the International Building Code (IBC), edition currently enforced.

B. The program of Special Inspection and Structural Testing is a Quality Assurance program intended to ensure that the work is performed in accordance with the Contract Documents.

C. This specification section is intended to inform the Contractor of the Owner's quality assurance program and the extent of the Contractor's responsibilities. This specification section is also intended to notify the Special Inspector, Testing Laboratory and other Agents of the Special Inspector of their requirements and responsibilities.

D. The Owner has obtained the services of qualified testing/inspection company to perform the special inspections and structural testing required by Chapter 17 of the International Building Code (IBC), edition currently enforced.

1.02  CONTRACTOR RESPONSIBILITIES

A. The Contractor shall cooperate with the Special Inspector and his agents so that the special inspections and testing may be performed without hindrance.

B. The Contractor shall be responsible for coordinating and scheduling inspections and tests. The Contractor shall notify the Special Inspector or Testing Laboratory at least 24 hours in advance of a required inspection or test. Uninspected work that required inspection may be rejected solely on that basis.

C. The Contractor shall provide incidental labor and facilities to provide access to the work to be inspected or tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.

D. The Contractor shall keep at the project site the latest set of construction drawings, field sketches, approved shop drawings, and specifications for use by the inspectors and testing technicians.

E. The Special Inspection program shall in no way relieve the Contractor of his obligation to perform work in accordance with the requirements of the Contract Documents or from implementing an effective Quality Control program. All work that is to be subjected to Special Inspections shall first be reviewed by the Contractor's quality control personnel.

F. The Contractor shall be solely responsible for construction site safety.
1.03 LIMITS OF AUTHORITY

A. The Special Inspector or Testing Laboratory may not release, revoke, alter, or enlarge on the requirements of the Contract Documents.

B. The Special Inspector or Testing Laboratory will not have control nor responsibility over the Contractor’s means and methods of construction.

C. The Special Inspector or Testing Laboratory shall not be responsible for construction site safety.

D. The Special Inspector or Testing Laboratory has no authority to stop the work.

END OF SECTION
SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 PROJECT CONDITIONS

A. This Section is not intended to limit types and amounts of temporary construction facilities and controls required. Omission from this Section will not be accepted as an application that such temporary activity is not required for successful completion of the work and compliance with requirements of the Contract Documents.

B. Provide and maintain each temporary construction facility and control when required for proper performance of the work. Terminate and remove when no longer needed or when permanent facilities are authorized and available for use. Provide maintenance personnel to perform this work in accordance with the requirements. Maintenance time will include normal working hours for all trades and start up and shut down overtime as required.

C. Obtain and pay for all required applications, fees, permits and inspections required for temporary construction facilities and controls.

D. Install, operate, maintain and protect temporary construction facilities and controls in a manner and at locations which are safe, non-hazardous, sanitary and adequately protect project work, workmen and the public.

1.02 COST OF CONSUMED UTILITIES

A. Water Service Use Charges: Water consumed during construction is to be metered and paid for by the Contractor.

B. Electric Power Service Use Charge: Cost of electric power consumed during construction is to be metered and paid for by the Contractor.

C. Sewer Service Use Charges: The cost of providing portable toilets will be paid by the General Contractor. Where existing building toilet facilities are used, there will be no charge for sewer usage by all entities authorized to be at or to perform work at the project site.

D. Propane for Temporary Heat: Prior to, and after, the structure being permanently enclosed: Paid for by the contractor requiring the temporary heat.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

A. Provide and maintain all temporary facilities in compliance with governing rules, regulations, codes, ordinances and laws of agencies and utility companies having jurisdiction over work involved in project.
B. Be responsible for all temporary work provided, and obtain any necessary permits and inspections for such work.

C. Contractors shall confine equipment, storage of materials, and operation of workmen to the limits indicated or directed and shall abide by law, ordinances, conditions stated in permits and directions of the Architect.

D. Do not interfere with normal use of roads in vicinity of project site except as indicated or as absolutely necessary to execute required work, and then only after proper arrangements have been made with authorities having jurisdiction, including traffic control as applicable.

1.04 SPECIAL PRECAUTIONS AND REQUIREMENTS

A. Do not interfere with normal use of occupied areas in existing buildings, existing driveway access to existing building and existing building utility services, except as absolutely necessary to execute required work involving such facilities, and then only after proper arrangements have been made through the Owner with persons in charge of existing facilities. Do not block required exits from existing buildings.

1.05 TEMPORARY FIELD OFFICES, TRAILERS AND TELEPHONE

A. Provide and maintain clean weather tight offices at the site for own use and the use of the A/E and authorized agents when needed to be present on site while the work is in progress. Provide field office heated, lighted and provide with telephone service. All expenses in connection with the field office, including the installation cost and use cost of heat, air conditioning, light, water and janitor service.

B. Copies of permits, approved shop drawings, plans and specifications marked up-to-date with all revisions and all addenda shall be kept at said offices areas ready for use at all times.

C. All expenses in connection with Contractor's field offices, including the installation cost and use of telephones, shall be borne by the Contractor.

D. Maintain field office areas until final acceptance and then remove, unless the Owner orders or approves earlier removal.

E. Pay all costs, including utility installation costs to the field office.

F. Provide and maintain additional storage trailers on the project as required. Locate where directed by the Owner.

G. Contractor may be required to relocate their offices, as directed by the Owner, during construction as work progresses.

1.06 TEMPORARY SANITARY FACILITIES

A. Provide temporary portable toilets, acceptable to public health authorities, as required to service the project. Maintain in a clean, sanitary condition. Locate as directed by Architect.
1.07 TEMPORARY WATER SERVICE

A. General: Water is available from water main indicated on site drawings.

B. Arrange for, provide and pay for temporary water connections to water main, installation of metered extension and suitable fixtures at termination of lines.

C. Provide sufficient branch lines of adequate size to serve the needs of all trades. Locate water supplies at convenient locations, as directed by Architect.

D. Provide insulated housings for temporary service lines to protect against freezing.

1.08 TEMPORARY HEAT AND VENTILATION

A. Prior to permanent enclosure of the structure, provide temporary heat as necessary to complete the work.
   1. Provide weather protection as required to carry on work during inclement weather and to protect work and materials from damage by weather.
   2. Protection of work includes covering, temporary enclosures, heating materials, work under construction and for suitable working conditions.
   3. Furnish temporary heat by Owner approved types of units or equipment which is safe, will not affect surrounding areas of Contract Work and is properly supervised while in use.

B. "Permanently enclosed" shall mean that permanent walls and roofs are in place and weather tight, windows are in place and glazed and all entrance enclosures are either permanently in place or provided with suitable temporary enclosures.
   1. Polyethylene sheet is not considered a suitable temporary enclosure. One-half inch thick plywood tightly fit, sealed and supported and maintained can be considered a temporary enclosure.

C. After the structure is permanently enclosed, provide, operate and maintain until substantial completion, approved temporary heating and ventilating units to maintain that portion of the structure at suitable temperature and humidity conditions to complete the work.
   1. Arrange temporary units to bring in sufficient outdoor air to ventilate the structure and to prevent build-up of harmful dusts and fumes and to remove excess moisture. During warm weather, provide an adequate supply of fresh air, when necessary, to properly ventilate moisture, dust, fumes from paints, cements or adhesives in tightly-enclosed areas where natural ventilation will not be sufficient.
   2. Provide temporary heating and ventilating as follows:
      a. During normal working hours, minimum 50°F.
      b. During placing, setting and curing of concrete, minimum 50°F.
      c. For 10 days prior to placing interior finish materials and throughout interior finishing, painting, etc., and until final acceptance of work and occupancy by Owner, minimum 70°F.
      d. Supply heat and ventilation in a manner which avoids rapid drying of material but permits material and building to dry so remaining moisture will not affect finish material.
      e. Operate temporary systems each day, including Saturdays,
Sundays and holidays. Include necessary labor and approved operating personnel.

f. Supply all fuel required for temporary heating and ventilating, including all material, labor and supervision to connect same.

D. When permanent systems are used for temporary construction use, Contractor shall assume full responsibility for maintaining such equipment during and after use. Included in maintenance are the following:

1. Proper operation and maintenance of the mechanical equipment until acceptance of the project by Owner.
2. Maintenance of temporary filters in all equipment to prevent accumulation of dust and dirt in coils, housings and ductwork.
3. Prior to final inspection; replacement of temporary filters with new filters, thorough cleaning of coils and other equipment, putting entire system into first class condition, cleaning traps and devices, adjustment and removal of any and all materials and equipment not functioning properly.
4. Owner and Architect must be given access to and opportunity to inspect equipment and maintenance procedures at all times. Owner involvement will not relieve the Contractor from the responsibilities specified herein.

E. Use of permanent heating or cooling and ventilating equipment for temporary construction use shall not affect warranty. Warranty shall take effect at time of project acceptance by Owner.

F. Cost of Temporary Heat: Cost of all fuel consumed in conjunction with temporary heat or permanent system used for temporary heat shall be paid by the Contractor.

1. Electric resistance type heating units are not permitted.

G. During periods of extremely low temperatures when water pipes could possibly freeze or when such conditions are forecast, temporary heating must be monitored 24-hours a day, 7 days a week.

1.09 TEMPORARY LIGHT AND POWER

A. Provide necessary temporary electrical service and temporary wiring and outlets as required to meet project needs for temporary lighting and power at the start of the project, as work progresses and until acceptance by the Owner, excluding power to individual contractor’s trailers.

B. Extend temporary service from public utility service. Provide meter and extend service with disconnect to central location on site and to electric panel board location near Contractors’ office trailer area. Provide system sized as required to service project construction needs. Construct temporary pole line as required.

C. Remove temporary service, light and power system when permanent services and systems are available for use. No temporary system component shall form a part of the permanent systems.

D. Electrical work for construction purposes shall conform to Federal, State and local safety requirements, and requirements of the National Electrical Code. Obtain and pay for required applications, permits and inspections pertaining to this work.
E. Provide all lamps required to service the project. Replace lamps and fuses throughout the life of the project.

F. Pay all costs for installation, maintenance, supervision and removal of temporary light and power systems.

G. Make connections for temporary heat. Check temporary heat requirements.

H. Temporary Lighting
   1. Provide as required to service the project.
   2. As interior partitions are erected, revise the temporary lighting arrangements so that not less than one lamp is provided in each space over 70 square feet in area. Lights shall also be installed, as directed by Architect, in smaller areas where required to provide adequate light for work being carried out in the space.

I. Both 240 volt and 120 volt power receptacles are required on the project.

1.10 CONSTRUCTION AIDS

A. Hoists and Cranes: Erect and maintain adequate hoisting facilities as required for the work.

B. Shoring and Bracing: Provide all shoring and bracing required for safety and proper execution of their work. Remove these items when the work is completed.

1.11 WEATHER PROTECTION

A. Protect work and existing or adjacent property against weather, to maintain work, materials, apparatus and fixtures free from injury or damage during the entire construction period. Work likely to be damaged shall be covered or protected at the end of each day's work. Work damaged by not providing protection required, shall be removed and replaced with new work at the Contractor's expense.

B. Remove all snow and ice as may be required for proper protection and execution of the work and protection and safety of the public.

C. Provide winter weather closures and temporary doors at all unclosed openings.

1.12 WATCHMAN SERVICE

A. If Contractor considers watchman services necessary for protection of his/her own interest, such services may be employed at his/her own complete expense.

1.13 SAFETY

A. Safety requirements shall be in accordance with the General Conditions.

B. Provide and maintain guard lights at all barricades, railings, obstructions in the roadways or sidewalks and at all trenches or pits adjacent to walks or roadways.
C. Strict attention and full adherence must be given the Williams-Steiger Occupational Safety and Health Act of 1970, U.S. Department of Labor.

1.14 SECURITY CONDITIONS

A. Security of building must be maintained during "non-standard" working hours (premium time). This includes, but is not necessarily limited to, verifying all entrance doors and windows are secured.

B. Contractor will be responsible for all infractions of rules and regulations by workers.

C. Loitering or wandering through the corridors and into rooms not connected with the project or into other buildings on site will not be permitted.

D. Erect a 6 foot high fence with gates to enclose construction site.
   1. Material: Heavy chain link mesh with steel posts.
   2. Location: As indicated on Drawings.
   3. Provide metal gates, of same fabric as metal fence, where indicated.
   4. Maintain fence and gates in working order at all times.
   5. Except during working hours, keep gates locked at all times.

1.15 DUST CONTROL

A. Control dust originating within project limits using water or a dust palliative acceptable to the Architect. When conditions create blowing dust and dirt that is considered higher than normally encountered, Contractor shall cooperate with A/E in determining methods to help minimize blowing; which at a minimum, may involve more frequent applications of dust palliative. Calcium chloride may not be used.

1.16 TEMPORARY SIGNS

A. Temporary Project Sign.
   1. Provide project sign approximately 4 feet by 8 feet.
   2. Painting by professional sign painter, with text, design, layout and colors as directed by Architect.
   3. Materials: 3/4” APA-AB-EXT. Plywood for sign face with pine or fir trim. Provide 4 x 4 treated wood posts of sufficient length and quantity to securely brace and support sign against wind pressure.
   4. Locate sign as directed by Architect. Maintain until completion of project, then remove. Erect sign a minimum of 8 feet from public right of way.

B. Temporary Directional Signs: Provide as required to adequately direct traffic and personnel on site.

1.17 STREETS AND TRAFFIC

A. Cleaning and Repair
   1. Contractors shall remove mud and spillage from public walks, streets and sewers without delay. Failure to clean areas promptly will result in areas being cleaned by the Owner at the responsible Contractor's expense.
   2. Damage to roads, facilities or site, resulting from hauling, storage of
materials, or other activities in connection with the work shall be repaired or replaced at no expense to the Owner by the Contractor causing the damage. Repairs or replacements will be to the satisfaction of the A/E.

B. Traffic
   1. Notify local law enforcement agency at least two weeks in advance of any anticipated work affecting traffic flow.
      a. To assure maintenance of flow and to safeguard all parties involved in planning to maintain flow, a field inspection should be made jointly by the Architect and Contractor personnel before performing any work which would interrupt normal traffic patterns.
      b. Re-routing of traffic shall be planned, as to route and direction, in cooperation with the local law enforcement agency.

1.18 PARKING
A. Employees of Contractors and subcontractors must park vehicles in areas assigned to them. Parking on streets or in restricted areas is prohibited.

1.19 CONSTRUCTION LAYOUT AND FIELD ENGINEERING
A. Employ a registered surveyor, [registered in the State of Alabama] to lay out the building on the site and to locate and fix all site items such as site improvements and utilities and furnish a certified plat of this work. Be responsible for accuracy of all lines, elevations and measurements of the work. Exercise proper precaution to verify dimensions shown on Drawings before layout of the work.

B. 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.

C. General: Surveyor, registered in the State of Alabama to lay out the building on the site and to locate and fix all site items such as site improvements and utilities and furnish a certified plat of this work. Work includes:
   1. Establish benchmarks and control points to set lines and levels at each story of construction and as needed to locate each element of Project.
   2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   3. Inform installers of lines and levels to which they must comply.
   4. Check the location, level and plumb, of every major element as the Work progresses.
   5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
   6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

D. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

E. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those
required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

F. 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 A/E

G. Field Engineering

1. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   a. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
   b. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

2. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   a. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
   b. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
   c. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3. Certified Survey: 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.

4. Final Property Survey: Surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
   a. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
   b. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

END OF SECTION
SECTION 01 57 23
TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.01 JURISDICTION

This project is under the jurisdiction of the Tennessee Department of Environment and Conservation (TDEC) and a Storm Water Pollution Prevention Plan (SWPPP) has been filed. TDEC has provided a Construction General Permit (CGP) Notice of Coverage (CGP-NOC or just NOC). Under a NOC, the Owner is primary permittee, and the Contractor is considered a secondary permittee and may be referred to as a Construction Site Operator, by virtue of having day-to-day operational control of those activities at a project which are necessary to ensure compliance with a SWPPP for the site or other permit conditions.

1.02 RELATED SECTIONS

A. Copies of the NOC and SWPPP are normally included in the specifications but formatted without a specification section number. They may follow this Section or may be added by addendum or modification, and are to be considered a part of this Section. A copy of each, not bound into larger volumes of the Contract Documents, may be obtained from the Designer for ease of carrying out the requirements below.

B. Other technical aspects of the SWPPP are described in the Contract Documents where appropriate.

1.03 BASIC COORDINATION AND MONITORING

A. NOC: Post a copy of the NOC in a prominent, public location, such as a general notices board where building permit, employment regulations, and prevailing wage rates are posted. Protect the NOC from weather without obstructing its visibility. Repair or replace the NOC if it becomes damaged or missing.

B. SWPPP:

1. Maintain a copy of the SWPPP on site at all times. If a construction office/trailer is on site, keep the SWPPP documents inside it in a designated location. If there is no office/trailer, construct a SWPPP box and store the SWPPP documents therein. If the site is inactive, or does not have an on-site location adequate to store and protect the SWPPP, post a notice alongside the NOC telling where the SWPPP is stored, with a contact name and phone number. If the SWPPP is located off-site, provide reasonable local access to it during normal working hours.

2. Make updated plans and inspection reports available upon request to the operator of the local MS4, inspectors, and local agencies approving EPSC plans, grading plans, or storm water management plans.

C. RAINFALL MONITORING:

1. Maintain a rain gage on site, or determine a reliable local reference resource for rainfall monitoring. Some TBR campuses have such a resource. A resource off of the immediate campus where the project is located is not adequately local for normal daily readings. On days when Contractor's forces are not on site, if an on-campus local resource is unavailable, a rainfall reading can be obtained from a reliable nearby resource.

2. Take 24-hour rainfall depth measurement readings at a consistent time of day each day. When a rain event occurs, record the approximate beginning and ending time. Record the daily readings on the Weather Delay Report, Section 01 26 25, even if Work is not delayed.

3. Keep a copy of rainfall records with the SWPPP.
D. **EPSC FIELD PLANS**: A set of Erosion Prevention and Sediment Control (EPSC) plans shall be designated “field plans” and used to show modifications and updates and the date of each change, which can be hand-written on the sheets. Maintain these field plans nearby the overall project record documents.

E. **SITE ASSESSMENT**: As soon as SWPPP Site Assessment features are in place, notify the Designer that the Work is ready for the SWPPP Site Assessment.

F. **TWICE-WEEKLY INSPECTIONS**:

1. Conduct inspections of the storm water control measures twice-weekly and at least seventy-two (72) hours apart. Where sites or portion(s) of sites have been temporarily stabilized, or runoff is unlikely due to extreme drought, or winter conditions such as freezing or snow or ice covering, written notification may be submitted to the local environmental field office that inspections are being curtailed; and, if not objected to by that office, then such inspection may be conducted only once per month until construction activity resumes or thaw or precipitation results in runoff. Inspection requirements do not apply after Work has achieved final stabilization.

2. The person making the inspections must have active certification, having completed the TDEC “Fundamentals of Erosion Prevention and Sediment Control Level 1” course.

3. A “Construction Stormwater Inspection Certification (Twice-Weekly Inspections)” form must be filled out by the inspector for each inspection. Keep copies of completed forms with the SWPPP. Blanks of this form can be found in the Tennessee Erosion and Sediment Control Handbook, Fourth Edition, August 2012, appendix C, as issued by the Tennessee Department of Environment and Conservation.

G. **FINAL STABILIZATION**: Submit statement of final stabilization to the Designer when permanent site work is in place and temporary storm water control measures have been removed, typically when requesting substantial completion inspection, at the substantial completion inspection, or when requesting final inspection. Final stabilization is defined as seventy percent (70%) density of a permanent groundcover over all previously disturbed area(s).

H. **RECORD DOCUMENTS**: In addition to keeping the Project Record Documents complete with as-built conditions, at Final Stabilization assemble all twice-weekly inspection reports and site audit reports, and include these in the Project Data Binders.

PART 2 – PRODUCTS

PART 3 – EXECUTION

END OF SECTION
SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1  GENERAL

1.01  SUMMARY

A. Requirements of this Section apply to the Work of all other Sections.

B. Section Includes:
   1. Transportation and Handling.
   2. Storage and Protection.
   3. Standards.
   4. Manufacturers and Types.
   5. Fabrications.
   7. Prohibited Materials and Methods.

1.02  RELATED SECTIONS

A. Quality Control: Section 01 40 00.

B. Cutting and Patching: Section 01 73 29.

C. Shop Drawings, Product Data and Samples: Section 01 33 23.

D. Execution Requirements: Section 01 73 00.

1.03  STANDARDS

A. Standards, codes and regulations published by Manufacturer's Associations, governmental agencies and other regulatory authorities form a part of these Specifications as minimum requirements. Such references include the latest issue and all amendments up to 30 days prior to the Bid Date.

B. "Governing Authority" means all federal, state and local laws and regulations.

C. Where differences occur between the Contract Documents and such standards, the most restrictive requirement shall apply.

D. Supply all materials and perform all work in accordance with the Manufacturer's Specifications and installation procedures, and in conformance with published trade / manufacturer's association standards, unless specifically noted otherwise.

1.04  TRANSPORTATION AND HANDLING

A. Arrange deliveries of products in accordance with construction schedules and installation, coordinate to avoid conflict with work and conditions at the site.
   1. Transport products by methods to avoid product damage.
2. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
3. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and accepted submittals, and that products are properly protected and undamaged.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

1.05 STORAGE AND PROTECTION

A. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

B. Store products in accordance with manufacturer's instructions with seals and labels intact and legible.
   1. Store products subject to damage by the elements in weathertight enclosures.
   2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.
   3. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

C. Exterior Storage
   1. Store fabricated products above the ground, on blocking or skids, to prevent soiling or staining. Cover products which are subject to deterioration with impervious coverings. Provide adequate ventilation to avoid condensation.
   2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign materials.
   3. Store foam plastic away from exposure to sunlight, except to extent necessary for period of installation and concealment.

D. Arrange storage in a manner to provide access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage.

E. Protection After Installation: Provide coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

PART 2 PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

A. Products include materials, equipment and systems.

B. Products incorporated into the work:
   1. Comply with specifications / reference standards as minimum requirements
   2. Undamaged.
3. Manufactured and fabricated products:
   a. Design, fabricate and assemble in accordance with the best engineering and shop practices.
   b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
   c. Two or more items of the same kind shall be identical, by the same manufacturer.
   d. Products shall be suitable for service conditions.
   e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are approved in writing by A/E.

4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

5. New and unused at time of installation, except as otherwise indicated.

6. 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.

7. Provide products complete with accessories, trim, finish, fasteners, other items needed for a complete installation and indicated use and effect.

2.02 MANUFACTURER AND PRODUCT SELECTION PROCEDURES

A. Specified Product: Where specifications name a single manufacturer and product or refer to a single manufacturer and product indicated on the drawings, provide the named product. Comparable products or substitutions for Contractor's convenience will not be considered.

B. Specified Manufacturer: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

C. Multiple Specified Products: Where more than one manufacturer and specific product is listed, provide one of the products named. No substitutions will be permitted after signing the contract. Comparable products or substitutions for Contractor's convenience will not be considered.

D. Multiple Manufacturers: Where specifications include a list of manufacturers names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

E. Basis of Design: Where specifications name a Basis of Design or refer to a Basis of Design product indicated on the drawings, the design is based on the product listed. Subject to compliance with requirements, provide the specified product or a product manufactured by one of the other manufacturers listed.
   1. The characteristics of the Basis-of-Design Product establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
   2. Equipment or materials from these manufacturers will be acceptable.
contingent upon their meeting the design, appearance and functional standards established by the specified items. If equipment or a material of an acceptable manufacturer requires changes; electrically, mechanically, structurally, from what is indicated on the drawings, it shall be the responsibility of the Contractor requiring such change, to pay all costs involved with no additional costs to the Owner.

3. Submit evaluations as follows:
   a. Submit proposed comparable products for evaluation by the Architect at least two weeks prior to awarding contract to the manufacturer of a comparable product.
   b. Obtain samples of Basis-of-Design product.
   c. Select comparable products that comply with the characteristics specified. Submit evidence demonstrating compliance.
   d. Submit samples of comparable products displayed side-by-side with samples of Basis-of-Design products. Architect will determine whether the proposed comparable product is acceptable. Architect is not obligated to prove non-equivalence of proposed comparable products.

F. Where a performance is specified and no manufacturer is listed, submit through the Shop Drawing procedure the name of the manufacturer, the product proposed, and detailed information showing its characteristics. Such proposal shall meet or exceed the specification, line by line item, or be rejected.

G. Equivalent components (articles, devices, materials, forms of construction, fixtures, etc.) may be submitted to the A/E for approval prior to bidding regardless of listed manufacturers.

H. Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.03 FABRICATION

A. Fabricate all items in the shop insofar as practicable. Where items cannot be completely shop fabricated and assembled for shipment, assemble and fit in shop, disassemble and ship. Identify parts for field assembly.

B. Fabricate items to be straight, square, in proper alignment, and with hairline joints where joints are necessary and permitted. Pre-plan field joints to be as inconspicuous as possible; coordinate locations with Architect.

2.04 SHOP PRIMING

A. Shop prime or seal surfaces of products to receive paint materials in accordance with the requirements of Section 09 91 00. Apply a primer or sealer compatible with the specified paint materials.

B. If a primer is found incompatible with the specified finish paint system, provide a barrier coat or remove the primer and reprime, at no additional cost to the Owner.
2.05 PROHIBITED MATERIALS AND METHODS

A. The following items are expressly prohibited:
   1. Attachment Related Items
      a. Powder Fasteners: Powder fasteners are defined as anchors which are driven into place by any device which produces an impact force by use of a powder charge, compressed air, gas or any other propellant. Powder fasteners prohibited for the following conditions:
         1) Attachment of structural members.
         2) Where public may be endangered by misuse.
      b. Plug anchorage by use of wood, lead or plastic.
      c. Perforated steel strap iron for pipe or other support or anchorage.
      d. Suspension systems that are not independently supported.
         1) Ceiling grid systems shall not be supported from ductwork, electrical conduit, heating or plumbing lines, and vice versa.
         2) Each utility system and the ceiling system shall be a separate installation, each independently supported from the building structure.
         3) Where interference occurs, provide trapeze type hangers or other suitable supports for each system.
         4) Locate hangers and supports where they will not interfere with access to mixing boxes, fire dampers, valves, and other appurtenances requiring servicing.
   2. Methods Related Items
      a. The penetration of floors and walls by pipes, ducts, or other penetrations unless openings are appropriately fire stopped by fire doors or fire dampers, and voids around pipes, ducts, conduits, etc. are sealed with fireproof materials.
      b. The use of ink marking pens on surfaces of any kind of materials receiving paint or other finish in exposed location.
   3. Materials Related Items
      a. Asbestos or asbestos containing materials.
      b. Barbed wire in construction fencing.
      c. Water soluble treatment of insulation jackets or facings, to impede or retard smoke or flames.
   4. Masonry Related Items
      a. Chicken wire type masonry reinforcing.
      b. Cinder block.
      c. Muriatic acid.
   5. Door Related Items
      a. Knock-down (KD) door frames.
      b. Thresholds raised more than 1/2" at doors indicated as wheel chair accessible.
   6. Roofing Related Items
      a. Dead level roofs. All roofs must slope to drain.
      b. Pitch pans or pitch pockets.

PART 3 EXECUTION
Not Applicable

END OF SECTION
PART 1 - GENERAL

1.01 ENVIRONMENTAL HAZARDOUS PRODUCTS, MATERIALS, OR WASTES

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

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

C. Select materials and products meeting specified requirements which comply with EPA requirements as regards hazardous materials content. In making requests for substitutions, determine that materials and products proposed for substitution comply with RCRA, CERCLA, and EPA requirements.

END OF SECTION
SECTION 01 71 23
FIELD ENGINEERING

PART 1 GENERAL

1.01 SUMMARY

A. This section specifies administrative and procedural requirements for field engineering services, including, but not necessarily limited to, the following:
   1. Establishing and maintaining lines and levels;
   2. Structural design of shores, forms and similar items provided by the subcontractor as part of their means and methods of construction.

1.02 SUBMITTALS

A. Project Record Documents: Where applicable, each contractor shall submit a record of work performed as required under the provisions of Section 01 78 39, Record Documents.

1.03 QUALITY ASSURANCE

A. Use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

PART 2 PRODUCTS
Not Applicable

PART 3 EXECUTION

3.01 GENERAL

A. Each trade contractor is responsible for any and all layout required to complete their scope of work.

B. Verify layout information shown on the drawings, in relation to the property survey and existing benchmarks before proceeding to the layout work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.

C. 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, or requirements to relocate reference points because of necessary changes in grades or locations.

D. Promptly replace lost or destroyed project control points. Base replacements on the original survey control points.
E. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction.

F. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer and water service piping.

3.02 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.

B. Advise entities engaged in construction activities of marked lines and levels provided for their use. Provide a minimum of two column lines as control in two directions which shall be used as reference points.

C. As construction proceeds, check every major element for line, level and plumb.

D. Surveyor’s Log: Maintain a surveyor’ log of control and other survey work. Make this log available for reference.

E. 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.

F. Existing Utilities: Furnish information necessary to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in, or affected by construction. Coordinate with local authorities having jurisdiction.

END OF SECTION
SECTION 01 73 00
EXECUTION REQUIREMENTS

PART 1  GENERAL

1.01  SUMMARY

A. Requirements of this Section apply to the Work of all other Sections.

B. Section Includes:
   1. Examination of Substrate.
   2. Preparation.
   3. Installation.
   4. Workmanship.
   5. Protection.

1.02  RELATED SECTIONS

A. Quality Control: Section 01 40 00.

B. Cutting and Patching: Section 01 73 29.

C. Shop Drawings, Product Data and Samples: Section 01 33 23.

D. Product Requirements: Section 01 60 00.

1.03  STANDARDS

A. Standards, codes and regulations published by Manufacturer's Associations,
governmental agencies and other regulatory authorities form a part of these
Specifications as minimum requirements. Such references include the latest issue
and all amendments up to 30 days prior to the Bid Date.

B. "Governing Authority" means all federal, state and local laws and regulations.

C. Where differences occur between the Contract Documents and such standards,
the most restrictive requirement shall apply.

D. Supply all materials and perform all work in accordance with the Manufacturer's
Specifications and installation procedures, and in conformance with published
trade and manufacturer's association standards, unless specifically noted
otherwise herein.

1.04  NON-CONFORMING WORK

A. Faulty work or work not in conformance with the Contract Documents will not be
permitted by the Architect.
1. It is the responsibility of the Contractor to propose a remedy by means of detailed drawings and written documentation and submit such documentation to the Architect for comments.

2. All costs for the removal and reconstruction of such work, as well as additional services of the Architect, shall be paid for by the Contractor.

**PART 2 PRODUCTS - NOT APPLICABLE**

**PART 3 EXECUTION**

3.01 EXAMINATION OF SUBSTRATE

A. Examine the substrates or structure to which a product is to be applied or installed. Do not proceed until unsatisfactory conditions have been corrected. Starting the work indicates acceptance of conditions and the installer assumes full responsibility for results.

B. Check the substrate or structure for proper tolerances and clearances. Tolerances are listed under individual specification Sections.

3.02 PREPARATION

A. Substrate: Where the products are applied to a substrate, prepare substrate as recommended by the product manufacturer. That generally includes the following:

1. Bringing substrate to a uniform surface by smoothing uneven surfaces and filling holes, cracks and depressions with recommended filler or compatible type material.

2. Depressed Slabs: Bring to required elevation to receive finished materials where finished materials cannot completely fill depression. Use approved cementitious filler or compatible type material. Coordinate depressed slab locations with finish material locations.

3. Remove substances such as dust, oils and other foreign matter, not compatible with the product.

4. Surfaces shall be dry, unless moisture content or wetting requirement is specified or recommended.

B. Concrete Slabs: Provide steel shot abrasive cleaning of concrete slabs receiving designated finish flooring materials.

1. Designated Finish Flooring Materials
   a. Cementitious or cementitious set materials.
   b. Sheet flooring materials.
   c. Waterproofing materials.
   d. Paint materials.
   e. Polymer or epoxy type seamless flooring.

2. Equipment: Electric powered portable unit with self-contained dust collection system. Size(s) of unit(s) and shot media suitable for conditions and proposed finish materials. WHEELABRATOR CORP. "Blastrac" or similar type system by SASE COMPANY INC., BW MANUFACTURING or INNOVATECH.

3. Cleaning: Remove concrete surfaces to sufficient depth to remove bond
breakers and contaminants such as curing compounds, oils, and other foreign matter which may be detrimental to the completed flooring installation.

a. Work smoothly and evenly over entire surface; avoid creating dips, ridges, or other imperfections which would show or telegraph in the completed installation.

b. Small transitions for different flooring materials may be obtained by multiple passes if carefully executed to create smooth even slope of not more than 1/8" in 2 feet.

4. Clean floor as near as possible to flooring installation to avoid contamination from work of other trades. Protect clean floor from soiling with suitable sheet materials. Re-clean soiled areas.

C. Inserts and Anchorages

1. Anchorages where not detailed are the responsibility of the installer to design a suitable connection, structurally sound, and aesthetically acceptable to the Architect. Furnish calculations, drawings and product data when requested by the Architect. Such information may or may not be returned as indicated in Section 01 33 23.

2. It is the responsibility of the installer to furnish built-in fastening devices for his/her product to the proper trade for installation as the work proceeds.

3. In the event such devices are not furnished in time to be built-in, it is the installer's responsibility to provide other methods for attaching their product. Submit drawings and other required data to the Architect.

D. Templates: Provide templates, diagrams and other coordinating documents to the proper Contractor, manufacturer or supplier of related items affecting the Work.

E. Dimensions

1. If the exact location of an item is not indicated by dimension on the Drawings or noted in the Specifications, the Architect reserves the right to determine such location in the field prior to roughing-in.

2. If the exact dimensions of a product are not indicated, the Architect reserves the right to determine dimensions prior to the ordering or fabrication of a product.

3. Such dimensional changes shall not be a basis for changes in the Contract Sum.

4. Where miscellaneous devices, such as thermostats, switches, controls, grilles, pipes, or outlets of any nature are not specifically located by the Contract Documents, request such location or obtain approval of the location prior to installation. If approval has not been obtained, the Architect may direct the relocation of such devices at the expense of the installer.

3.03 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.
   a. Where pipes occur in partitions, furred-out spaces and chases, determine exact location and size and fit entirely concealed into allotted space. Report conflicts to Architect prior to installation.
   b. Where two or more pipes are to installed in parallel, or parallel to the piping of other trades, the piping shall be installed with sufficient space between the pipes to allow for the proper application of pipe covering, painting, and servicing.
   c. Furnish advance information on locations and sizes of frames, boxes, sleeves and openings needed for the Work to installers.
4. Install work to allow for installation of future work identified on drawings.
5. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.

B. Install products in accordance with manufacturer's recommendations or the requirements of trade associations, listed standards, Shop Drawings and Contract Documents.

C. If a conflict exists between these references, the most strict requirements govern. If printed instructions are not available, consult with the manufacturer or the manufacturer's field representative, where applicable.

D. Provide hangers, auxiliary framing, and other means for installing ceiling suspension systems, lighting fixtures, diffusers, and other equipment in ceilings to avoid ductwork, piping, etc.
   1. Suspend from structural members (i.e. joists, beams, etc.), and not from ductwork or piping.
   2. Provide supplemental framing members (i.e. angles, tubes, light gage steel framing, etc.) to span between structural members where required to support items of this paragraph C.

E. Install work that will not interfere with the proper installation of the Work of other trades.

F. Install work in a manner to facilitate operating, servicing and repairing.

G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

H. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

3.04 SPACE PREFERENCE

A. Carefully check and coordinate the location and level of all Work to avoid conflicts between all contractors. Where conflicts occur, the following preferences shall generally govern:
1. Recessed electrical light fixtures
2. High and medium pressure ductwork
3. Low pressure ductwork
4. Soil, waste, vent and storm piping
5. Sprinkler piping
6. Liquid heat transfer and refrigerant piping
7. Domestic water piping
8. Electrical conduits from branch circuits

B. However, no ductwork or liquid heat transfer main shall have preference over plumbing piping below plumbing fixtures, nor over electrical conduits above or below electrical switchgear and panels. No piping conveying liquids shall be installed directly over electrical or elevator equipment. No piping shall be installed in electrical or elevator equipment rooms.

C. Where headroom or space conditions resulting from application of these preferences appear inadequate, notify the Architect prior to installing the Work.

D. Coordinate the mounting heights of busways, electrical equipment and raceways to clear the opening heights of doors, the height of vehicles and the heights of equipment which needs to be routinely removed, and out of paths required for maintenance.

3.05 WORKMANSHIP

A. Install products straight, plumb, level and in line. Securely attach items to the substrate, using recommended adhesives, mechanical fasteners or other devices. Where holes are provided for attachment, do not field drill or cut new holes without the approval of the Architect.

B. Where applicable, match finished work to the approved samples or mock-ups.

C. Conceal fasteners wherever possible, unless exposed fasteners are permitted or specified.

D. Weld in accordance with AWS standards; comply with AWS for qualifications of operators and for workmanship.

E. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.

F. Recheck measurements and dimensions, before starting each installation.

3.06 PROTECTION

A. Protect finished surfaces of product being installed and surrounding products from damage during installation. Provide protective devices as required and as recommended by the manufacturer. Cover work subject to damage at the end of each day's work.
B. Coat concealed surfaces of metal products with a bituminous or other approved coating to prevent contact between dissimilar metals or other material which can cause deterioration.

C. Correct damage by repairing or replacing as directed by the Architect. Repairing will be permitted only where the repair is undetectable and does not cause structural damage or interfere with proper functioning of the part.

D. Protect finish of installed products until Substantial Completion of the Project by use of wrappings, covers or other approved protective devices. Remove such protection immediately prior to final cleaning.

E. Limiting Exposures: Coordinate and supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Maintain exposures within the manufacturers recommended limits. Where applicable, such exposures include, but are not limited to, the following:
   1. Excessive static or dynamic loading
   2. Excessive internal or external pressure
   3. Excessive high or low temperatures
   4. Thermal shock
   5. Excessively high or low humidity
   6. Air contamination or pollution
   7. Water or ice
   8. Solvents
   9. Chemicals
   10. Light
   11. Radiation
   12. Puncture
   13. Abrasion
   14. Heavy traffic
   15. Soiling, staining and corrosion
   16. Bacteria
   17. Rodent and insect infestation
   18. Combustion
   19. Electrical current
   20. High speed operation
   21. Improper lubrication
   22. Unusual wear or other misuse
   23. Contact between incompatible materials
   24. Destructive testing
   25. Misalignment
   26. Excessive weathering
   27. Unprotected storage
   28. Improper shipping
   29. Theft
   30. Vandalism

F. Take precautions to protect existing concrete and asphalt pavement from damage due to vehicle loads, parking, and storage.
1. Schedule loading to minimize pavement material consolidation during hot weather. Distribute wheel loads to the greatest extent possible.

3.07 OVERHEAD ATTACHMENTS

A. Where overhead hangers are required, and not indicated on the drawings, provide one or more of the following as required:
   1. Concrete inserts prior to placement of concrete or drilled type inserts after concrete is placed.
   2. Trapeze from adjacent structure with suitable steel framing.
   3. Connections to Structure: Suitable anchorage devices with a minimum load carrying capacity of 250 pounds plus safety factor of 4:1 for the applied load.
      a. Concrete: Steel expansion anchors. See Prohibited Material and Methods specified in Section 01 60 00.
      b. Steel: Bolted or welded connections to steel structure.

B. Where metal deck is furnished with hanger tabs or similar devices, applied total load, including work of other trades, not to exceed 75 pounds for each device. Loads in excess of permitted limit to be supported by trapeze framing as specified above.

C. Verify support requirements of heavy or unusual loads not specifically shown on drawings with Architect.

3.08 OPERATION AND MAINTENANCE

A. Contractor shall maintain all systems and equipment operated during construction. The contractor responsible for the installation of the system shall operate and maintain it. Make all repairs and perform all maintenance to assure Work is turned-over to Owner in first class condition.

B. Maintenance work includes:
   1. Lubrication
   2. Adjustments
   3. Filter replacements

END OF SECTION
SECTION 01 73 29
CUTTING AND PATCHING

PART 1 GENERAL

1.01 DESCRIPTION

A. Execute cutting, fitting or patching of Work, required to:
1. Make several parts fit properly.
2. Uncover Work to provide for installation of ill-timed Work.
3. Remove and replace defective Work.
4. Remove and replace Work not conforming to requirements of Contract Documents.
5. Remove samples of installed Work as specified for testing.
6. Install specified Work in existing construction.

B. In addition to contract requirements, upon written instructions of Architect:
1. Uncover Work to provide for Architect's observation of covered Work.
2. Remove samples of installed materials for testing.
3. Remove Work to provide for alteration of existing Work.

C. Do not endanger any Work by cutting or altering Work or any part of it.

1.02 SUBMITTALS

A. Prior to cutting which affects structural safety of Project, submit written notice to Architect, requesting consent to proceed with cutting, including:
1. Identification of Project.
2. Description of Affected Work.
4. Affect on other Work, on structural integrity of Project.
5. Description of proposed Work. Designate:
   a. Scope of cutting and patching.
   b. Contractor and trades to execute work.
   c. Products proposed to be used.
   d. Extent of refinishing.
6. Alternative to cutting and patching.
7. Designation of party responsible for cost of cutting and patching.

B. Should conditions of Work, or schedule indicate change of materials or methods, submit written recommendation to Architect, including:
1. Conditions indicating change.
2. Recommendations for alternative materials or methods.

C. Submit written notice to Architect, designating time Work will be uncovered, to provide observation.
PART 2 PRODUCTS

2.01 MATERIALS

A. Patching of materials and surfaces shall be in accordance with the requirements of the Contract Documents. Where not otherwise defined, patching shall match adjacent surfaces and proper materials shall be provided accordingly.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect existing conditions of Work, including elements subject to movement or damage during cutting and patching.

B. After uncovering Work, inspect conditions affecting installation of new products.

3.02 PREPARATION PRIOR TO CUTTING

A. Provide shoring, bracing and support as required to maintain structural integrity of Project.

B. Provide protection for other portions of the Project, including all Contractors' personnel.

3.03 PERFORMANCE

A. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances, finishes.

B. Execute cutting and demolition by method which will prevent damage to other Work, and will provide surface to receive installation of repairs and new Work.
   1. No cutting shall be performed which will, in any way, reduce the structural strength of the building. Should such cutting be necessary, consult A/E and do not proceed with such operation unless written approval is given.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

C. Restore Work which has been cut or removed; install new products to provide completed Work in accord with requirements of Contract Documents.

D. Patching of materials and surfaces shall be in accordance with the requirements of the Contract Documents. Where not otherwise defined, patching shall match existing or adjacent surfaces and proper materials shall be provided accordingly.
   1. Wherever existing walls, floors, ceilings, etc., are cut, the exposed surfaces must be neatly finished by patching, painting, wall covering, etc., as required to blend patched areas into adjacent existing surfaces. Patched areas shall not be visible when viewing entire wall surface.
      a. Provide an even surface of uniform finish, color, texture, and
appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

2. Where painting or finishing of patched surfaces or application of wall or floor covering is required, finish the entire plane of surface in which patched area occurs.

3. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

3.04 SLEEVES AND OPENINGS

A. Where pipes, conduits, ductwork or other materials pass through new walls, partitions, floors, roof or ceilings, provide suitable sleeves in these elements or provide openings where sleeves are not practical.

B. Close sleeves and openings to prevent passage of smoke or fire using approved methods and materials to maintain the fire rating of the construction being penetrated. See Section 07 84 00.

1. Unless otherwise indicated, extend floor sleeves 2" above finished floor.

C. Where pipes, conduit, ductwork etc., pass through, behind, or above existing construction, provide all cutting, patching, and refinishing for doing this work as specified herein.

D. Lintels: Provide steel or precast concrete lintels to span openings in masonry walls sized in accordance with schedule shown or as detailed on structural drawings. In general, lintels are not required for openings less than the width of masonry unit in which wall is being constructed. Penetrations under beams or other concentrated loads require approval of Architect.

3.05 CLEANING

A. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

END OF SECTION
**SECTION 01 74 00**

**CLEANING**

**PART 1  GENERAL**

1.01  GENERAL REQUIREMENTS

A. These requirements supplement paragraph 3.15, General Conditions. Refer to General Conditions for additional requirements.

B. Execute cleaning, during progress of the work and at completion of the work, as required by Contract Documents.

1.02  RELATED SECTIONS

A. Cutting and Patching: Section 01 73 29.

B. Cleaning for Specific Products or Work: Specification section for the work.

1.03  CLEANING AND DISPOSAL REQUIREMENTS

A. Standards: Maintain project in accord with these safety and insurance standards:
1. Applicable Federal and State Requirements.

B. Hazards Control: All trades shall comply with the following requirements:
1. Store volatile wastes in covered metal containers; remove from site daily.
2. Prevent accumulation of wastes which create hazardous conditions.
3. Provide adequate ventilation during use of volatile or noxious substances.

C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
1. Do not burn or bury rubbish and waste materials on project site.
2. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary sewers.
3. Do not dispose of waste into streams or waterways.
4. Wet down dry materials and rubbish to prevent dust.

D. Clean streets, highways, and private properties of all mud, earth, rubbish, rocks, refuse or other debris of any kind resulting from such work or related transportation to and from the work site.

**PART 2  PRODUCTS**

2.01  MATERIALS

A. Select and use cleaning materials and equipment with care to avoid scratching, marring, defacing, staining or discoloring surfaces cleaned.

B. Use only cleaning materials recommended by MFR of surfaces to be cleaned.
C. Use cleaning materials only on surfaces recommended by cleaning material MFR.

**PART 3 EXECUTION**

3.01 PROGRESS CLEANING

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

B. Provide, maintain and empty 55 gallon metal and dumpster type containers for collection of waste materials, debris and rubbish. Locate containers as directed by Architect. Provide containers with adequate capacity to accommodate anticipated needs. If containers do not have adequate capacity, increase intervals of waste removal or capacity of containers until adequate capacity is provided.

C. At reasonable intervals during progress of Work, but in no case less than once a week, dispose of waste materials, debris and rubbish.

D. Site: Maintain Project site free of waste materials and debris.

E. 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.

F. 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.

G. Direct Special Attention To:
   1. Provide non-staining layout lines / other markings on masonry and concrete
      Use chalk lines wherever possible and remove when no longer needed.
   2. Remove all stains from concrete surfaces, including floors.
   3. Shop marks shall not appear on exposed surfaces of any item.
   4. Remove concrete, mortar and paint spatters.
   5. Clean both brick and concrete unit masonry.
   6. Protect aluminum frames during construction and thoroughly clean upon completion of the installation.

H. Clean interior surfaces before start of finish painting and continue cleaning on an as-needed basis until painting is finished.

I. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

J. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.
K. Vacuum interior building areas where work is performed prior to painting and other finish work. Continue vacuum cleaning on an as needed basis until building is ready for occupancy.

L. Protect interior of ductwork during construction from accumulation of dirt, dust or debris.

M. Clean trash from all chases and concealed spaces before final enclosure.

3.02 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. Leave Project clean and ready for occupancy.

B. Employ experienced workmen, or professional cleaners for final cleaning.

C. At the completion of the work, remove all surplus material, false work, temporary structures, including foundations, plants of any description and debris of every nature resulting from operations and put the site in a neat and orderly condition.

D. Clean exposed interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.

E. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

F. Sweep concrete floors broom clean in unoccupied spaces.

G. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

H. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed interior and exterior surfaces, including light fixtures and lenses; polish surfaces so designated to a shine finish.
   1. Clean finishes free of dust, stains, films and other foreign substances.
   2. Clean transparent and glossy materials to a polished condition; remove foreign substances. Polish reflective surfaces to a clear shine.

I. Remove temporary protection and labels not required to remain

J. Clean surfaces of equipment; remove excess lubrication.

K. Remove debris, rubbish, dirt, etc. from open concealed spaces, chases and above ceilings.

L. Repair, patch and touch-up marred surfaces to specified finish, to match adjacent surfaces.
M. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

N. Remove waste, foreign matter, and debris from roofs, gutters, areaways, and drainage systems.

O. Clean plumbing fixtures to a sanitary condition.

P. Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, clean ducts, blowers and coils when units have been operated without filters during construction.

Q. Clean light fixtures and lamps; polish lenses.

R. Clean dirt and debris from interior of all electrical panels and user accessible electrical enclosure boxes prior to installation of covers or in the case of hinged access doors, before final cleaning of adjacent space. Clean the exterior surfaces of all switchgear located in Mechanical and Electrical Rooms and spaces.

S. 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 original condition.

T. Clean dirt and dust from interior of air handling units before installing final filters. Wipe down the exterior surfaces of all HVAC equipment located in Mechanical Rooms and spaces. Exposed painted ductwork to be brushed clean of dust.

U. Site/Exterior Items: 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.
   1. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   2. Rake grounds that are neither planted nor paved to a smooth, even textured surface.
   3. Remove tools, construction equipment, machinery, and surplus material from Project site.
   4. Clean exposed hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces.

V. Maintain cleaning until Final Completion.

W. Prior to Final Completion, or Owner occupancy, Contractor shall conduct an inspection of sight exposed interior and exterior surfaces, and all work areas, to verify that the entire work is clean.

END OF SECTION
SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1  GENERAL

1.01  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.

1.02  RELATED SECTIONS
A. Sustainable Design Requirements: to be included in the project manual in the
   Construction Document issue.
B. Selective Demolition - for disposition of waste resulting from partial demolition of
   buildings, structures, and site improvements: Section 02 41 19.
C. Masonry – for disposal requirements for masonry waste: Section 04 00 00.

1.03  DEFINITIONS
A. Construction Waste: Building and site improvement materials and other solid
   waste resulting from construction, remodeling, renovation, or repair operations.
   Construction waste includes packaging.
B. Demolition Waste: Building and site improvement materials resulting from
   demolition or selective demolition operations.
C. Disposal: Removal off-site of demolition and construction waste and subsequent
   sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities
   having jurisdiction.
D. Recycle: Recovery of demolition or construction waste for subsequent
   processing in preparation for reuse.
E. Salvage: Recovery of demolition or construction waste and subsequent sale or
   reuse in another facility.
F. Salvage and Reuse: Recovery of demolition or construction waste and
   subsequent incorporation into the Work.

1.04  PERFORMANCE GOALS
A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by
   weight of total nonhazardous solid waste generated by the Work. Practice
   efficient waste management in the use of materials in the course of the Work.
Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.05 QUALITY ASSURANCE

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

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

C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00, "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.

1.06 SUBMITTALS

A. Waste Management Plan: Submit 2 copies of plan within 14 days after the Notice to Proceed.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include separate reports for demolition and construction waste. Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste in tons.
   4. Quantity of waste salvaged, both estimated and actual in tons.
   5. Quantity of waste recycled, both estimated and actual in tons.
   6. Total quantity of waste recovered (salvaged plus recycled) in tons.
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit three (3) copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
F. 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.

G. 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.

H. Qualification Data: For waste management coordinator and refrigerant recovery technician.

I. 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.

1.07 QUALITY ASSURANCE

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

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 19 "Project Meetings." Review methods and procedures related to waste management including, but not limited to:
   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.

1.08 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
   1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

**PART 2**  PRODUCTS (Not Used)

**PART 3**  EXECUTION

3.01 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

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

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials to be salvaged, recycled, reused, donated, and sold.
   2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.02 SALVAGING DEMOLITION WASTE

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

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

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

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

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

F. Plumbing Fixtures: Separate by type and size.

G. Lighting Fixtures: Separate lamps by type and protect from breakage.

H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.03 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner’s property and transport to recycling receiver or processor.

3.04 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Break up and transport paving to recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
   1. Pulverize concrete to maximum 1-1/2-inch size.
   2. Crush concrete and screen to comply with requirements in Division 31 Section "Earthwork" for use as satisfactory soil for fill or sub base.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
   1. Clean and stack undamaged, whole masonry units on wood pallets.

D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

E. Metals: Separate metals by type.
   1. Structural Steel: Stack members according to size, type of member, and length.
   2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

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

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

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

I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

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

K. Plumbing Fixtures: Separate by type and size.

L. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
M. Lighting Fixtures: Separate lamps by type and protect from breakage.

N. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

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

3.05 RECYCLING CONSTRUCTION WASTE

A. Packaging
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees at landfill facility.
   1. Comply with requirements in Division 32 Section "Plants" for use of chipped organic waste as organic mulch.

C. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
      a. Comply with requirements in Division 32 Section "Plants." for use of clean sawdust as organic mulch.

D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.06 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION
PART 1 - GENERAL

1.01 PRE-CLOSEOUT SUBMITTALS

A. Submit required tabulations when Work reaches seventy-five percent completion; however, regardless of percent completion, submit not later than 30 days prior to the scheduled date on which Substantial Completion is required.

B. Submit tabulations of:
   1. Equipment and systems for which the specifications require demonstrations or training, indicating relevant specification sections, scheduled time and place for demonstration and training sessions, and intended audience. Adjust schedule if instructed by Designer to do so.
   2. Equipment and systems for which operating and maintenance data are required in the Operating and Maintenance Data Binders and related documents are required in the Project Data Binders.
   3. Spare parts and extra materials required, indicating the relevant specification sections, and the appropriate party to whom the items are to be delivered.

1.02 REQUEST FOR CLOSEOUT INSPECTION

A. SUBSTANTIAL COMPLETION:
   When Contractor considers Work substantially complete, Contractor shall submit to Designer:
   1. written assertion that Work is Substantially Complete;
   2. a list of items to be completed or corrected and dates scheduled for completion or correction of each item;
   3. certification that orientation and training for facility maintenance personnel is complete or written assertion that such orientation and training will be certified prior to inspection;
   4. written assertion that Operating & Maintenance Data Binders are complete and available or will be prior to inspection;
   5. when a Use and Occupancy Permit applies, a copy of the final approval(s), or written assertion that they will be complete and available prior to inspection;
   6. a draft of the application for payment corresponding to the substantial completion, with written assertion that an application for payment will be ready and submitted at the inspection;
   7. when there is Commissioning, written assertion that Commissioning requirements have been completed or will be prior to inspection.
   8. when there is a storm water permit, written statement of the status of final stabilization required under the Storm Water Pollution Prevention Plan (SWPPP) for the TDEC Construction General Permit (CGP) Notice of Termination (NOT).

B. FINAL INSPECTION:
   When Contractor considers Work complete, Contractor shall submit to Designer:
   1. certification that a qualified person authorized by Contractor has reviewed the Contract Documents and inspected the Work;
   2. written assertion that the Work is complete and in accordance with Contract Documents and ready for Final Inspection;
   3. written assertion that additional materials necessary to augment the Operating & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and available or will be prior to inspection;
   4. written assertion that Project Data Binders and Construction Record Documents are complete and available or will be prior to inspection; and,
   5. an application for final payment.
C. Upon receipt of an appropriate request for inspection, Designer will schedule an inspection meeting with Contractor, and Owner's representatives to determine the status of completion.

1.03 RESULTS OF CLOSEOUT INSPECTIONS

A. Should the Designer determine that Work is not complete to the degree asserted by Contractor, Designer will promptly notify Contractor in writing stating the deficiencies. Contractor shall take immediate steps to remedy deficiencies and make a request for Re-Inspection.

B. SUBSTANTIAL COMPLETION: Designer will prepare a Certificate of Substantial Completion accompanied by a list of items to be completed or corrected, and will submit Certificate to Contractor and to Owner for signature with an accounting of Liquidated Damages due, when Designer verifies that:

1. Work is Substantially Complete based on an inspection conducted pursuant to an appropriate request for Closeout inspection;
2. orientation and training for facility maintenance personnel is complete; and,
3. Operating & Maintenance Data Binders are complete and have been delivered to the Owner.

C. FINAL INSPECTION: Designer will certify that the Work is Complete, and will initiate Final Adjustments, when Designer verifies that:

1. Work is complete in accordance with Contract Documents based on an inspection conducted pursuant to an appropriate request for Closeout inspection;
2. orientation and training for facility maintenance personnel is complete; and,
3. additional materials necessary to augment the Operating & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and have been delivered to the Owner.
4. Project Data Binders and Construction Record Documents are complete and have been delivered to the Designer.

1.04 RE-INSPECTION FEES: If the Work fails a Closeout inspection, and a subsequent inspection is requested and conducted based on Contractor assertion of the same stage of completion, Owner will compensate Designer for performing such Re-Inspection as additional services, and deduct the amount of such compensation from the Contract Sum by appropriate modification.

1.05 FINAL ADJUSTMENTS

A. When Designer has certified that the Work is complete, Designer will determine whether modification is needed to reflect appropriate adjustments to Contract Sum which were not previously effected. If such modification is needed, Designer shall assist the Owner in its preparation and deliver it to Contractor, who in the case of a change order, shall sign and return it to Designer.

B. When Designer has certified that the Work and needed modifications to the Contract are complete, and if necessary, Designer will instruct Contractor to submit a revised final application for payment.

1.06 ONE-YEAR CORRECTIVE INSPECTION

A. An inspection will be scheduled and conducted at project site prior to one year from date Substantial Completion was achieved, but as close to the end of that year as is reasonably possible.

B. The inspection will be attended by at least one representative each of Owner, Designer, and Contractor.

C. The inspection will confirm non-conforming items previously identified for correction by the Owner, and whether corrections have been completed or are still outstanding, and is intended to be an opportunity for Contractor to become aware of any outstanding corrections needed.

END OF SECTION
PART 1 - GENERAL

1.01 DATA BINDERS

A. Provide two complete sets in durable, commercial quality, plastic covered, three ring binders. Identify project and type of data on face and saddle.

B. Provide information required by Contract Documents, including:
   1. Cover sheet giving complete project title and number, Contractor's name, address, phone number, superintendent's name, and related information.
   2. Table of Contents identifying material in Binder, and identifying missing materials to be added later or certifying completeness of Binder.

C. OPERATING & MAINTENANCE DATA BINDERS
   1. Provide Product Data. Include: manufacturer; model number; names, addresses, & telephone numbers of suppliers, installers, & servicers; related information for repair, renovation, or additions.
   2. Provide Operating and Maintenance Data, including: instructions and schedules for proper operation, maintenance, servicing, and lubrication with manufacturer's parts list, illustrations, assembly drawings, maintenance diagrams, and list of recommended lubricants and cleaning agents; as-installed control diagrams and coordination drawings with color coded piping and wiring diagrams; valve tag charts with numbers, locations, and functions; panel board circuit directories; and, list of materials and parts furnished for Owner. Review brochures and manufacturer's standard printed information for data pertaining to models other than those actually provided, and mark to clearly omit inapplicable information and identify units actually installed.
   3. If Commissioning applies, provide Commissioning functional performance test certifications and data. If separate binders of this information have not been submitted already, provide a third copy in a separate binder.
   4. If a SWPPP applies, provide a section into which the Designer can add the Storm Water Operation & Maintenance Plan.

D. PROJECT DATA BINDERS
   1. On the form exhibited as Section 01 78 88, provide a complete list of subcontractors and material suppliers, including dollar amount, company name, address, phone number, local representative, and information regarding minority-owned business status. List general contractor as first entry.
   2. Provide a copy of the Certificate of Substantial Completion.
   3. Provide a copy of the State Fire Marshal's Certificate of Occupancy, and other Use and Occupancy Permits, Certificate(s) of Inspection, or letter(s) of acceptance from governing authorities as apply.
   4. Provide guarantees, warranties, bonds, certifications, maintenance agreements, service contracts, and related documents, including beginning date, duration, information about instances which might affect validity, and proper procedure in case of failure.
   5. If a SWPPP applies, provide the twice-weekly inspection reports and site audit reports.

1.02 CONSTRUCTION RECORD DOCUMENTS: Keep the record copy of Contract Documents required by paragraph 3.11 of the Conditions in good condition and in the course of the Work, legibly mark these to record actual conditions of Work, including: location, depth, and identification of new and existing underground items, utilities, valves, tap points, equipment, service access, test points, and related features; field changes in dimensions and detail; changes by addenda or Modification; and, description and details of features for maintenance, service, replacement, or expansion of the Work.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED SECTIONS
   Section 01 29 76 Payment Procedures
   Section 01 77 70 Close-Out Procedures
   Section 01 78 21 Close-Out Submittals

1.02 CONTRACTOR PREPARATION AND USE OF THIS FORM

   A. Use this form or a reasonable facsimile to verify delivery of Data Binders. Fill in the identifying information following this paragraph, then use the prepared form as a receipt, for signature by the person to whom Data Binders are delivered. Provide a copy of the receipt with the application for payment.

      1. For the Application for Payment commensurate with Substantial Completion, provide a copy indicating delivery of Operating and Maintenance Data Binders.
      2. For the Application for Payment commensurate with Final Completion, provide a copy indicating delivery of Project Data Binders.

   B. Identifying Information:
      1. For the Work:
         - **Project Title:**
           (SBC project number, institutional location, and work name)

      2. For the Data Binder(s), mark **only one** of the boxes below:
         - ONLY Operating & Maintenance Data Binder
           (due at substantial completion inspection)
         - ONLY Project Data Binder
           (due at final inspection)
         - BOTH data binders

1.03 RECIPIENT SIGNATURE

   A. By signature below, recipient acknowledges receipt of the Data Binder identified above, but does not certify the completeness or correctness of the Data Binder.

   **Recipient Signature:**
   Legibly indicate recipient’s name and title or affiliation with Owner or Designer

END OF SECTION
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<th>Work performed or Material Supplied, and Dollar Value</th>
<th>Firm name and address</th>
<th>Principal Contact and Phone</th>
<th>If a Minority-Owned Business, classification and certifying agency. If not, “NO”.</th>
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PART 1 - GENERAL: not used

PART 2 - PRODUCTS: not used

PART 3 - EXECUTION

3.01 Equipment Start-up / Commissioning

A. Conduct demonstration and instruction as soon as practicable upon installations, and prior to Substantial Completion inspection. Substantial Completion shall not be certified, nor shall Owner be required to assume responsibility for operating, maintaining, or insuring system, prior to complete demonstration and instruction.

B. Demonstrate operation of newly provided equipment and systems to Designer and to Owner's representative. Instruct Owner's personnel in operation, adjustment, and maintenance of equipment and systems, using the operating and maintenance data as the basis of instruction.

C. Make lists of persons witnessing equipment and systems demonstration, and persons receiving operating instruction, using a format similar to the form included in Section 01 79 25 with project, subject, trainer, session information, and attendees identified. Include copy of lists in the Operating and Maintenance Data Binders.

END OF SECTION
PART 1 – GENERAL

1.01 Use a copy of this page as a planning form for demonstrations and training. Fill in the basic identifying information below:

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<th>SBC Project Number:</th>
<th>Required date of Substantial Completion</th>
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<td>Institution/Location:</td>
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<td>Project Name:</td>
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<td>Owner’s Facility Coordinator:</td>
<td>Phone:</td>
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<td>Owner’s Maintenance Contact:</td>
<td>Phone:</td>
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<td>Contractor Contact:</td>
<td>Phone:</td>
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1.02 If a list of required demonstrations and training has been specified in Division 1, use that list as a starting point, review the project manual for other specifications that require training of the Owner’s operators, and complete the list below. Check the box on left if Demonstration and Training is required on the standard listed subjects; add subjects as identified by review of the specifications and check the box to the left of each; and, schedule and indicate an target date for each. If the number of training subjects exceeds the available space provided here, replace or continue the list on a similarly formatted separate page. Submit the list with the initial Progress Schedule, and update as necessary during the Work to ensure that advance notice of the demonstration and training schedule is acceptable to the Designer.

<table>
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<tr>
<th>Spec Reference</th>
<th>Subject</th>
<th>Target Date</th>
<th>Actual Date</th>
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<td>Accessibility</td>
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PART 2 – PRODUCTS: not used.

PART 3 – EXECUTION

3.01 For each session conducted, use this page as a **Training Verification Report**.

A. Fill in the information below prior to the session (“End Time” may be filled in after):

   SBC Project Number: ___________________________
   Institution/Location: ___________________________
   Project Name: _________________________________

   **Subject Equipment / System:**
   Spec ___________________________
   Reference ___________________________

   **Demonstration and Training (by whom, where, when):**
   Trainer Name: ___________________________
   Company: ___________________________
   Phone: ___________________________
   Place: ___________________________
   Date: ___________________________
   Start Time: ___________________________
   End Time: ___________________________

B. **Minimum Agenda Requirements:**

   [ ] System Walk-through  [ ] Operation  [ ] Trouble-shooting  [ ] Maintenance  [ ] Safety

C. **Attendance:** Each person receiving the demonstration and training shall sign in below, or on a similarly formatted continuation page:

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**END OF SECTION**
PART 1 – GENERAL

1.01 Complete the processes of commissioning selected equipment and systems as specified. These should be listed in a companion section following this section. The absence of such a section does not negate the commissioning responsibilities. In the absence of such a section, review the specifications for commissioning requirements and provide a summary list as a submittal to the Designer for approval prior to performing the required commissioning.

1.02 SUBMITTALS

A. Functional Performance Testing:
Prepare and submit to the Designer Functional Performance Testing Procedures for approval of equipment and systems. Contractor will use forms provided in this section of the specifications. Testing procedures will be detailed step-by-step and specific to each system. The approved procedures will be used to conduct the Functional Performance Testing. Functional Performance Testing will be completed prior to Substantial Completion.

B. Commissioning Data:
Upon completion of the Functional Performance Testing, the Contractor will submit to the Designer the Commissioning section of the Operation and Maintenance Binder. The binder will be divided into sections. The binder will contain copies of the manufacturer’s installation and start-up procedures utilized by the installer and/or contractor, completed Functional Performance Testing Procedures and associated forms from Sections 23 08 xx and 26 08 xx, signed Functional Performance Test Certificates, and equipment and maintenance records for equipment and systems operated prior to Owner acceptance.

1.03 ROLES:

A. Designer, using its Consultants will:
   1. Review and approve the contractors Functional Performance Testing Procedures.
   2. Report on field observations and report deficiencies to the contractor.
   3. Observe the contractors Functional Performance Testing.
   5. Review final Commissioning Data.

B. Contractor:
   1. Prepare and provide Functional Performance Testing Procedures for Designer approval.
   2. Provide installation and start-up of all equipment and systems as prescribed by the manufacturer’s procedures.
   3. Perform and maintain a maintenance and service log for equipment and systems that are being operated prior to Owner acceptance.
   4. Provide manpower, supplies, testing instruments, etc. required to perform Functional Performance Testing.
   6. Prepare three (3) sets of Commissioning Data for Designer review and approval.
1.04 SYSTEMS TO BE COMMISSIONED:

A. The following Mechanical systems and associated equipment are to be Commissioned as specified in Sections 23 08 xx.
   1. Mechanical (HVAC) Air and Water
   2. Associated Controls and Building Automation
   3. Domestic Hot Water

B. The following Electrical systems and associated equipment are to be Commissioned as specified in Sections 26 08 xx.
   1. Electrical panel boards.
   2. Power Circuits.
   3. Lighting levels.
   4. Generator and/or Back-up Power sources.

PART 2 – PRODUCTS: NOT USED

PART 3 – EXECUTION

3.01 Commissioning Construction Phase:
Complete the following Commissioning activities during the Construction Phase of the project. Submit for review and provide notification of activities.

A. Manufacturer’s system/equipment start-up procedures.

B. Specified manufacturer’s and/or independent testing agency reports.

C. Project schedule that included dates for start-up of equipment and systems, and Functional Performance Testing.

D. Minimum seven (7) day notification of code required testing and specified cleaning of systems.

E. Minimum seven (7) day notification of system and equipment start-up.

F. Control submittal on systems and equipment including drawings, sequences and programming.

G. Prepare detailed Functional Performance Testing Procedures for systems and equipment. Utilize the forms provided in this section of the specifications. Procedures will be detailed, step-by-step, and include description of expected results for verification. Modify test procedures as required by the Designers’ comments. Coordinate and schedule tests so that all parties involved will be present for final testing and acceptance.

H. Correct all deficiencies prior to final acceptance.

I. Prepare a list of all system and equipment warranties specified in the contract documents. Provide the warranty item and the contract document section number. Provide the Designer with an update list throughout the project.

J. Prepare a list of all deliverables specified in the contract documents. Provide the deliverable item and the contract document section number. Provide the Designer with an updated list throughout the project.
K. Prepare a list of all Training and Demonstrations specified in the contract documents. Provide the type of Training and/or Demonstration and the contract document section number. Provide the Designer with an updated list throughout the project.

L. Prepare a list of all tests, reports, services, etc. whether required by codes, independent authorities, or manufacturers as specified in the contract documents. Provide the type of test, report, services, etc. and the contract document section number. In the case that the test is required by state or local codes, update the list as soon as the information is available. Provide the Designer with an updated list throughout the project.

M. Systems and/or equipment will not be used for temporary purposes of any kind until authorized by the Designer in writing to ensure that required maintenance and warranties remain in force. The Contractor will be responsible for maintenance of all systems and equipment until final acceptance and will maintain on site a binder containing schedules of maintenance activities, items checked, repairs or replacements made and documents to verify that the work was performed. The documentation contained in this binder will become part of the Commissioning Binder.

3.02 Commissioning Acceptance Phase:
Complete the following Commissioning activities during the Acceptance Phase of the project. The activities described in this section must be completed prior to substantial completion.

A. Perform Functional Performance Tests of Mechanical and Electrical systems and equipment as specified utilizing the testing procedure prepared by the Contractor and approved by the Designer to verify proper calibration, operation and performance. The Contractor is responsible for providing all manpower, equipment and/or testing instruments required to perform tests. Functional Performance Testing will be performed in the presence of the Designer/Consultant and the Owner. Tests that fail to perform as required, will be retested upon correction. If retesting has to be rescheduled, the Contractor will be responsible for any additional charges.

B. All deliverables prescribed in the contract documents will be delivered to the Owner at the location designated by the Owner.

C. Perform all Training and Demonstrations prescribed in the contract documents.

D. Provide three (3) Final Commissioning Binders to the Designer for review and approval. Ensure that all forms are completely filled out and all testing results documented. If missing or incomplete information and/or data is identified by the Designer, reassemble replacement manuals with complete information prior to project final payment.

END OF SECTION
### Performance Testing Identification Form

**Section 01 91 23**

**Performance Testing Identification Form**

**Owner's Project Number:** 166/

**Institution or Campus:**

**Building:**

**Installer:**

**System/Unit Identifier:**

**Location:**

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**List Each Piece of Equipment Associated with This System and/or Unit by Tag #**

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<th>Piece of Equipment</th>
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SECTION 01 91 29
FUNCTIONAL PERFORMANCE TEST CERTIFICATION

Owner's Project #: 166/

Identification of Equipment or System: ________________________________

Location of Equipment or System: ________________________________

Manufacturer / Supplier: ________________________________

This date: ________________________________

Functional Performance Test Procedure No: ________________________________

Components Included: ________________________________

The above systems and components integral to this equipment are complete and have undergone Functional Performance Tests. All Functional Performance Test procedures are complete and have been checked off only by parties having direct knowledge of the event, as indicted below, respective to each responsible contractor. This Functional Performance Test is submitted for approval and is subject to the attached list of outstanding items not completed successfully. Contractor shall submit a Deficiency Form upon completion of any outstanding or deficient items. None of the outstanding items preclude safe and reliable functional tests being performed.

CHECK ONE:  Deficiency listing attached; or,  No Deficiencies Found.

All Designer and Contractor punch list items for this system and related equipment have been addressed and corrected prior to Functional Performance Testing.

The Functional Performance Test procedures were reviewed and approved by the installer and applicable subcontractors prior to testing.

CONTRACTOR'S CERTIFICATION OF PERFORMANCE:

I hereby certify that the above described equipment or system, has been energized, operated, adjusted, and balanced in accordance with requirements of the Contract Documents and the manufacturer's recommendations for a sufficient period to confirm that operation complies in all respects with the Contract Requirements.

Signature  Print Name  Date

Installer: ________________________________  ________________________________  ________________________________

General Contractor: ________________________________  ________________________________  ________________________________

Designer / Consultant: ________________________________  ________________________________  ________________________________
SECTION 02 32 01
GEOTECHNICAL INVESTIGATIONS

PART 1  GENERAL

1.01  SOIL BORINGS

A. Test borings have been made at the site of the improvements. Logs of the test borings are included in a report by GEOServices, LLC, dated July 11, 2017 and titled, “Report Geotechnical Exploration; DP Culp Center Expansion and Renovation; SBC Project No.: 166/005-01-2014A”; Johnson City, Tennessee. GEOServices Project No. 51-17054.

1. A copy of the report is available for examination at the office of the Architect; where copies may be obtained as follows:
   a) A scanned PDF of the report will be emailed upon request.
   b) A paper copy (only if required) will be provided for the cost of reproduction.

B. Logs of the test borings are not warranted by the Owner or the Architect, except that they reflect the best and only information available at the time of design.

END OF SECTION
SECTION 02 41 19

SELECTIVE BUILDING DEMOLITION

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. Work Included: The extent of demolition work is indicated on drawings, and includes, but is not necessarily limited to, the following:

1. Selective breaking up, dismantling and/or removal of existing building items.
2. Salvage of selected existing materials to be turned over to Owner as may be determined by the Owner or to be reused in the project.
3. Cutting and patching.
4. Clean up.
5. Filling of holes uncovered by demolition operations
   a. In addition to the quantity shown on the drawings, Bidders shall include an Owner’s stipulated allowance in the base bid for filling 100 holes smaller than 12 inches in any direction in the existing floor slabs in accordance with the typical detail on the structural drawings. This cost of this work is in addition to the cash allowances stipulated in Division 01 Allowance Section. Use of the stipulated allowance requires prior written authorization from the Owner through the Construction Manager. Unused quantities times the stipulated unit price on the bid form shall be returned to the Owner by way of a deductive change order during closeout and prior to final payment.
   b. In addition to the quantity shown on the drawings, Bidders shall include an Owner’s stipulated allowance in the base bid for filling 10 holes smaller than 36 inches but greater than 12 inches in any direction in the existing floor slabs in accordance with the typical detail on the structural drawings. This cost of this work is in addition to the cash allowances stipulated in Division 01 Allowance Section. Use of the stipulated allowance requires prior written authorization from the Owner through the Construction Manager. Unused quantities times the stipulated unit price on the bid form shall be returned to the Owner by way of a deductive change order during closeout and prior to final payment.

B. Removal of asbestos and other hazardous materials is not a part of this Contract. If asbestos or other hazardous materials are encountered during demolition, Contractor shall halt demolition operations in that area and notify Architect.

B. Removal of asbestos is a part of this Contract. An asbestos survey was made and a report was prepared for the demolition site by Professional Service Industries, Inc. (PSI). A copy of this report is included in this project manual.
1.02 RELATED SECTIONS

A. Cutting and Patching: Section 01 73 29.

B. **Sustainable Design Requirements:** Section 01 81 13.

C. Construction Waste Management and Recycling: Section 01 74 19.

D. Selective Site Demolition: Section 02 41 13.

1.03 PROJECT CONDITIONS

A. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished.
   1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner insofar as practicable. However, variations within the structure may occur by Owner's removal and salvage operations prior to the start of the Demolition work.
   2. It is solely the Contractor's responsibility to determine demolition procedure and sequence and to insure the safety of the building and its component parts during demolition. This includes the addition of whatever shoring, sheeting, temporary bracing, guys or tie-downs which might be necessary. Such material shall maintain the Contractor's property after completion of the project.
   3. It is solely the Contractor's responsibility to follow all applicable safety codes and regulations during all phases of the work.
   4. Existing Building: Provide temporary supports and other measures as required to prevent damage to the existing building during construction. Field verify all existing dimensions which affect the new construction.

B. Coordination
   1. Demolition sequence, phasing and methods must be approved by Architect prior to start of demolition work.
   2. Coordinate shoring with structural modifications. Shoring to be left in place until completion of structural work permits it's removal.

C. Title to Removed Property
   1. All removal items, unless otherwise indicated for salvage or reuse will become the property of the Contractor and shall be removed from the Site. During the demolition operations, Owner reserves the right to add to, or delete from, the list of items designated for reuse or salvage.
   2. Items to be salvaged for the Owner or for reinstallation are as indicated on the drawings.
   3. Site storage or sale of Contractor owned removed items will not be permitted.

D. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner. Carefully salvage in a manner to prevent damage and promptly return to Owner.
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 cleaned and reinstalled in their original locations after selective demolition operations are complete.

G. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities.
1. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.

H. Protections: Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.

I. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.

J. Utility Services
1. Locate and identify electrical and mechanical services passing through or located within affected area and serving areas outside the work limits.
2. Maintain existing utilities and protect against damage during demolition operations.
3. Shut-down periods
   a. Arrange timing of shut-down periods of all in-service utilities with the Owner. Do not shut down any utility without prior written approval.
   b. Keep shut-down period to a minimum or use intermittent period as directed.
   c. Some shut-down hours may be required after normal working hours. No extra compensation will be made for Work after normal working hours, weekends or holidays.

K. Scheduling: Conduct work so as to avoid interference with operations and work in areas of building which are to remain in service.

L. Permits, Fees and Inspections: Obtain and pay for all permits, fees and inspections required by governing authorities.
PART 2  PRODUCTS

2.01  MATERIALS

A. The Contractor shall furnish all materials, tools, equipment, supplies and labor required to perform the work in accordance with the Drawings and Specifications and within the time limits as specified. All work done under this contract shall conform to all current standards, building codes and ordinances. American National Standard for Demolition Operations – Safety Requirements, ANSI A10.6 (latest edition), is included by reference.

B. Shoring Materials: As determined by Contractor.

PART 3  EXECUTION

3.01  PROTECTION

A. Use water sprinkling, temporary enclosures and other approved methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, pollution and electrical shock.

2. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations, as directed by the Architect. Return adjacent areas to conditions existing prior to the start of the work.

B. In removal of existing materials, take care not to damage work remaining in place, salvageable materials or equipment. Repair or replace any existing construction, materials or equipment damaged during demolition to Owner's satisfaction at no additional cost.

C. Erect dust chutes and use for removal of materials, rubbish and debris.

3.02  DEMOLITION

A. Building Items Demolition

1. General
   a. Items specified herein or indicated on drawings.
   b. Where indicated to be removed and either turned over to Owner or reinstalled, use methods for removal which will provide the least potential adjacent materials to remain.
   c. Miscellaneous Items: Material or equipment encountered during construction which must be removed to aid in construction operations or that which will not be used in completed facilities.

2. Concrete and Masonry: Where cut line will be exposed in the finished work and where physically feasible, make edges by saw cutting.

3. New Door and Window Openings: Cut openings, install lintels and patch jambs and head as required to provide rough openings indicated on drawings.
4. Masonry: Demolish in small sections. Use bracing and shoring where necessary to avoid collapse of structure.

5. Removal of Masonry Units.
   a. Limits: As indicated on Drawings or as directed by Architect.
   b. Method.
      1) Remove to first full masonry unit beyond limits.
      2) Remove all old mortar from existing masonry units adjacent to new construction.
      3) Sufficiently brace opening when necessary until construction is completed.

6. Junction Points: Neatly repair the point of junction after removal of parts or all of masonry walls, slabs and like work which tie into new work or existing work, so as to leave only finished edges and surfaces exposed.

7. Except where Contract Documents require leaving an existing floor finish in place, completely remove existing flooring from locations where new finishes are scheduled. Leave top surface of substrate completely free from materials that would interfere with bond of new materials.

8. Completely remove existing carpet from areas to receive new floor finishes. Also remove pad and all traces of adhesive.

9. Floor Preparation: See Section 01 73 00, Execution Requirements.

10. Salvage face brick and limestone resulting from demolitions operations. Take caution not to mix face brick with common brick. Neatly stack on pallets as directed by Construction Manager.
   a. Face Brick: Salvage, clean and store for reuse.
   b. Common Brick: Remove from site.
   c. Limestone: Salvage, clean and store for reuse. Remove existing surface applied anchorage where present.

B. Mechanical (HVAC & Plumbing)
   1. Disconnect or shut off service to areas where mechanical work is to be removed.
   2. Remove all plumbing, heating, ventilating and air conditioning equipment, fixtures and related piping, ductwork and appurtenances as indicated.

C. Electrical
   1. Disconnect or shut off service to areas where electrical work is to be removed.
   2. Remove all electrical fixtures, equipment and related switches, outlets, conduit, wiring and appurtenances as indicated, except conduit in walls and ceilings not being removed may remain. If these conduits are left in place, cut ends are to be permanently sealed.

3.03 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Remove from site, debris, rubbish and other materials resulting from demolition operations.

B. Removal: Transport materials removed and dispose of off site except as follows:
   1. Transport material indicated to be "salvaged" to storage areas as directed by Architect. Storage areas are located on-site.
   2. Store salvaged materials, protected from dirt and damage.
C. Clean Up
   1. Leave interior areas "broom clean".
   2. Remove barricades as directed.
   3. Remove shoring.

3.04 FIELD QUALITY ASSURANCE/MONITORING PROGRAM

A. To be performed by Owner's Independent Testing and Inspection Agency

B. Before commencement of excavation and demolition, take color digital photographs of Project Site and surrounding facilities, including existing items to remain during construction from different vantage points, as necessary to show the condition of the existing facilities prior to the start of work. Surrounding facilities shall include, but not be limited to the Aquatics Center, the E/W six court gymnasium facility, surrounding sidewalks and streets to remain.

C. Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of temporary excavation support and permanent foundation support systems, Building Mass Demolition procedures, Selective demolition procedures.

D. Submit prior to the beginning of the Work.

E. Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures and site features. Establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

F. During installation of excavation support systems, permanent foundation support systems, mass demolition and selective demolition regularly resurvey benchmarks, maintain an accurate log of surveyed elevations, and positions for comparison with original potions and elevations. Promptly notify CM and A/E if changes in elevations or positions occur or if cracks, sags or other damage is evident in adjacent construction.

END OF SECTION
SECTION 03 01 30
CONCRETE CLEANING AND SEALING

PART 1 GENERAL

1.01 WORK INCLUDED
   A. Clean concrete surfaces and seal with clear compound specified herein. Coordinate sealer application with concrete curing compound (See Section 03 30 00).

1.02 REFERENCES
   A. ACI 515.1R - Guide to the Use of Waterproofing, Dampproofing, Protective, and Decorative Barrier Systems for Concrete.

1.03 SUBMITTALS
   A. Product Data: For each type of product. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.

1.04 QUALITY ASSURANCE
   A. Manufacturer: Certify in writing that proposed materials meet or exceed specifications and are appropriate for intended use.
   B. Test Sample: Identify an area approximately 36” x 36” where a test cleaning can be performed and sealer application can be applied. Obtain Architect's approval of test area prior to start of test. Clean area and apply sealer using materials and methods proposed for the project. Repeat sample applications until approval by Architect. After sample's acceptance by the Architect, sample will be regarded as the minimum standard of workmanship/finish acceptable for the project.

1.05 PROJECT CONDITIONS
   A. Do not apply materials when temperature is expected to be below 40° F within 48 hours or when rain is imminent.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
   B. Store materials in a clean, dry area in accordance with manufacturer's instructions. Keep product from freezing.
   C. Avoid direct contact with this product as it may cause mild-to-moderate irritation of the eyes and/or skin.
D. Protect materials during handling and application to prevent damage or contamination.

E. Use product full strength from the container.

F. Dispose of material according to all local, state and federal regulations.

**PART 2  PRODUCTS**

**2.01  MATERIALS, GENERAL**

A. Source Limitations: Obtain each color, grade, finish, type, and variety of product from single source with resources to provide products of consistent quality in appearance and physical properties.

B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

**2.02  CONCRETE CLEANING MATERIAL**

A. Description: Pre-mixed, pre-packaged degreaser/stripper.

B. Manufacturer and Product: Citrex by L & M CHEMICAL or Ultrite Degreaser by W. R. MEADOWS. Products by CHEM MASTERS, DAYTON SUPERIOR; MASTER BUILDERS SOLUTIONS; SURE BUILDING CHEMICALS or CONPROCO are acceptable providing they meet the requirements specified.

C. Properties
   1. Appearance: Clear.
   2. pH: 10.9.
   3. Biodegradable: 100% after dilution.

**2.03  CONCRETE SEALER**

A. Description: Clear, one component, transparent, acrylic copolymer sealer. 2-coat application.

B. Primer: Type as recommended by sealer manufacturer.

C. Properties
   1. VOC Content: Less than 170 g/L.
   2. Solids: 30%.
   3. ASTM C 1315, Type 1, Class A

D. Manufacturer and Product: Dress and Seal WB 30 by L & M CHEMICAL or equal products by CHEMMASTERS, DAYTON SUPERIOR; MASTER BUILDERS SOLUTIONS; SURE BUILDING CHEMICALS; W. R. MEADOWS or CONPROCO.
PART 3  EXECUTION

3.01  EXAMINATION

A. Examine surfaces to receive concrete degreaser. Notify architect if surfaces are not acceptable. Do not begin application until unacceptable conditions have been corrected.

3.02  SURFACE PREPARATION

A. Protect adjacent surfaces not designated to receive concrete degreaser.

B. Follow ACI Guide 515.1R (Section 3.4.2) for severe oil and grease stains.

C. Clean surfaces of residual flooring adhesive and other foreign deposits using warm water, scraping, adhesive removing chemicals or similar methods.

3.03  APPLICATION

A. Cleaner
   1. Conform to manufacturer's requirements and recommendations. Apply in number of applications as required.
   2. Finish cleaned surface to match test sample area.

B. Sealer
   1. Verify that slab surfaces have been cleaned in accordance with sealer manufacturer requirements.
   2. Conform to manufacturer's requirements and recommendations. Provide two coats. Apply first coat at approximately 300 square feet per gallon; second coat at approximately 400 square feet per gallon.
   3. Do not thin material.

3.04  CLEANUP

A. Dispose of material according to local, state, and federal regulations.

B. Clean all tools and equipment with water.

END OF SECTION
SECTION 03 01 31
CONCRETE PATCHING

PART 1 GENERAL

1.01 WORK INCLUDED
A. Pre-packaged grout (concrete patch) material.
B. Hydraulic cement leveling (transition) material.

1.02 UNIT PRICES
A. General: Unit prices include the cost of preparing existing construction to receive the work indicated.
B. Concrete Removal and Replacement or Patching: Work will be paid for by the cubic foot computed on the basis of rectangular solid shapes approximating the actual shape of concrete removed and replaced with average depths, widths, and lengths, measured to the nearest inch.
C. Epoxy Crack Injection: Work will be paid for by the linear foot of crack injected.
D. Polymer Overlays: Work will be paid for by the square foot of exposed overlay surface.

1.03 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.

1.04 SUBMITTALS
A. Product Data: For each type of product. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.
B. Samples for Initial Selection: Submit cured samples for each exposed product and for each color and texture specified.
C. Samples for Verification: Submit cured samples for each exposed product and for each color and texture specified.
D. Qualification Data: For installers and manufacturers.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Each manufacturer shall employ factory-trained technical representatives who are available for consultation and Project-site inspection and assistance at no additional cost.
B. Installer Qualifications: Trained and approved by manufacturer.

C. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for materials and execution for the following:
   1. Epoxy Crack Injection: Perform epoxy crack injection in two separate areas, each approximately 48 inches long
   2. Polymer Overlay: Apply approximately 20 sq. ft. area of polymer overlay.
   3. Polymer Sealer: Apply approximately 20 sq. ft. area of polymer sealer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.

B. Store cementitious materials off the ground, under cover, and in a dry location.

C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Source Limitations: Obtain each color, grade, finish, type, and variety of product from single source with resources to provide products of consistent quality in appearance and physical properties.

B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

2.02 MATERIALS

A. Grout: One-part, cementitious patching and repair material.
   1. Compressive Strength
      a. 28 days: 5500 psi.
      b. 3 days: 3500 psi.
   2. Bond Strength (ASTM C1042) - 28 days: 1400 psi.
   3. Manufacturer: Eucopatch by EUCLID CHEMICAL CO; SIKA; L&M CHEMICALS.

B. Water: Potable.

C. Hydraulic Cement: Sureflo by GEMITE or equal.

2.02 MIX

A. As recommended by manufacturer.
PART 3  EXECUTION

3.01  INSTALLATION

A.  Floor Patch Areas
1.  Location: Floor patch areas; wall patch areas; areas where quarry tile removed; where indicated.
2.  Finish top of patch flush with existing floor or adjacent wall surfaces.
3.  Clean grout material from adjacent materials not scheduled or required to receive patch material.

B.  Floor Transition/Leveling
1.  Location:  At cell block ranges at transition between existing quarry tile and areas of removed vinyl asbestos tile.
2.  Saw-cut existing concrete slab to receive feathered edge of cementitious topping.

END OF SECTION
SECTION 03 01 32
CEMENTITIOUS LEVELING

PART 1 GENERAL

1.01 WORK INCLUDED
A. Provide cementitious leveling for the following:
1. Self-leveling underlayment for application below interior floor coverings.
2. To reslope shower and toilet room areas.
3. Filling of floor "channels" where walls have been removed.
4. At other conditions where existing floor defects require patching and filling.

1.02 RELATED SECTIONS
A. Selective Building Demolition: Section 02 41 19.
B. Concrete: Section 03 30 00.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.
C. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.
D. Qualification Data: For qualified Installer.

1.04 QUALITY ASSURANCE
A. Installer: Specialist in the installation of materials specified and regularly engaged in the installation of same; qualified in, and familiar with, manufacturer's recommendations for the installation of materials.

1.05 PROJECT CONDITIONS
A. Environmental Conditions: Temperature, ventilation, time requirements and other factors affecting installation as recommended by manufacturer.
B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

1.06 DELIVERY, STORAGE AND HANDLING
A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.
PART 2  PRODUCTS

2.01  MANUFACTURERS

A. Specifications are based on products by ARDEX INC. The product catalog numbers listed herein are to establish a level of quality. Products by SIKA CORP., BASF, INC., MAXXON CORPORATION, DEPENDABLE or EUCLID CHEMICAL are acceptable provided they meet the requirements specified herein and design intent and usage indicated on the drawings.

2.02  MATERIALS

A. Self-Leveling Underlayment: ARDEX K-15; High strength, fast setting, non-shrink type. Conform to the following minimum requirements:
   1. Cement Binder: ASTM C150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219.
   2. Compressive Strength - ASTM C109: Minimum 4000 after 28 days.
   3. Final Set - ASTM C191: Approximately 2 hours at 70°F.

B. Primer: ARDEX P-51 "Ultra Prime"; two-part, non-flammable, non-toxic primer or ARDEX P-51 as recommended for substrates encountered.

C. Aggregate (For thicknesses over 1-1/2" +/-): Washed, well-graded gravel, 1/8"-1/4".

PART 3  EXECUTION

3.01  INSPECTION

A. Inspect surfaces to receive cementitious leveling and verify that conditions are satisfactory for the installation.

B. Substrate must be solid, clean, dry, and free from oil, wax, grease, curing compounds, latex compounds, gypsum, asphalt or other foreign matter.

C. Notify Architect of any conditions deemed unsatisfactory for the installation.

D. Installation of work under this Section is understood as acceptance of the substrates as satisfactory.

3.02  PREPARATION

A. Using materials recommended by underlayment manufacturer, remove all substances adversely affecting bond, and prime existing substrate.
   1. Fill cracks and other subsurface irregularities that may telegraph through fill or otherwise deem a detriment to a satisfactory concrete topping/fill application.

B. Verify that temperature control is provided to meet requirements of underlayment manufacturer.
3.03 INSTALLATION

A. Install all materials in accordance with manufacturer's recommendations and printed instructions.

B. Where thickness is greater than 1-1/2" +/-, provide aggregate as recommended by manufacturer; provide finish layer without aggregate to achieve smooth finish; feather edges.

3.04 PROTECTION

A. Installer to advise Contractor of protection requirements required to prevent damage from work of other trades including limits for foot traffic and equipment.

END OF SECTION
SECTION 03 01 33
CONCRETE REHABILITATION

PART 1  GENERAL

1.01  WORK INCLUDED

A. Patching of existing concrete surfaces of elevated walkways, support beams, stairs and landings, curbs, and tops of pier footings.

B. Topping of horizontal (top) surfaces of elevated walkways, stairs, landings, curbs.

C. Finish coating of vertical and horizontal surfaces, including edge beams of elevated walkways, stair landings and curbs.

1.02  QUALITY ASSURANCE

A. Installer: Licensed or approved by manufacturer of rehabilitation materials.

B. Manufacturer: Certify in writing that proposed materials meet or exceed specifications and are appropriate for intended use.

1.03  PROJECT CONDITIONS

A. Do not apply materials when temperature is expected to be below 40 degrees F within 48 hours or when rain is imminent.

PART 2  PRODUCTS

2.01  CONCRETE PATCH MATERIAL

A. Description: Portland cement based, polymer modified, fibre reinforced specially formulated concrete patching material. One or two component types acceptable.

B. Water: Potable; free of deleterious materials.

C. Properties

1. Compressive Strength - ASTM C109 (Modified): 5,500 to 6,500 psi.


3. Bond Strength: Concrete substrate fails before bond fails.

D. Manufacturer: Fibre-Patch (Complete Mix) by GEMITE. Products by DAYTON SUPERIOR; STONEHARD; SURE BUILDING CHEMICALS or CONPROCO are acceptable providing they meet or exceed the requirements specified.

2.02  CONCRETE TOPPING MATERIAL

A. Description: Two-component hydraulic cement based, fibre-reinforced polymer
modified material, especially formulated for protection and waterproofing of horizontal concrete, traffic bearing surfaces. Manufacturer: Gem-Top by GEMITE. Products by DAYTON SUPERIOR; STONEHARD; SURE BUILDING CHEMICALS or CONPROCO are acceptable providing they meet or exceed requirements specified.

B. Cement: Portland cement, ASTM C150, Type I. Aggregate: Silica sand, mesh 30 to 50, or mortar sand. Water: Potable; free of deleterious materials.

C. Mix: Proportions and sequences as recommended by manufacturer.

D. Properties
1. Compressive Strength - ASTM C109 (Modified): 5,000 to 5,500 psi.
2. Modulus of Rupture - ASTM C27: 800 to 1,000 psi.
3. Direct Tension Bond: 300 to 400 psi.
4. Freeze Thaw Resistance - ASTM C666: 0% weight loss after 300 cycles.

E. Thickness: 1/4 inch, minimum.

2.03 FINISH COATING

A. Description: Portland cement based, micro-fiber reinforced waterproof coating.

B. Color: As selected by Architect. Attain desired color by mixing of gray and white colors. Color to be uniform throughout entire project.

C. Thickness: Apply between 3 and 6 mils.

D. Manufacturer: Cem-Kote by GEMITE. Products by DAYTON SUPERIOR; STONEHARD; SURE BUILDING CHEMICALS or CONPROCO are acceptable providing they meet or exceed the requirements specified.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. As recommended by MFR and as indicated on drawings. As a minimum, remove loose concrete, clean surfaces of grease, laitance, dust, dirt and efflorescence.

3.02 APPLICATION

A. Conform to manufacturer's requirements and recommendations for mixing and application. Apply in number of applications as required and apply surface bonding coat (slurry) as required.

3.03 CLEAN-UP

A. Clean materials from all surfaces not scheduled to receive patching or topping materials.

END OF SECTION
SECTION 03 01 40.72
STRENGTHENING OF CAST-IN-PLACE CONCRETE

PART 1  GENERAL

1.01 DESCRIPTION

A. This specification section shall define the minimum requirements of the externally bonded composite strengthening system.

1.02 REFERENCES

A. General
   1. The latest reference edition available on the day of bid invite shall be used for all standards.

B. American Concrete Institute (ACI)
   2. ACI 562, Code Requirements for Evaluation, Repair and Rehabilitation of Concrete Buildings

C. American Society for Testing and Materials (ASTM)
   3. ASTM D7522, Standard Test Method for Pull-Off Strength for FRP Bonded to Concrete Substrate

D. International Concrete Repair Institute (ICRI)
   1. ICRI Technical Guideline No. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

E. ICC Evaluation Service (ICC-ES)
   1. AC125, Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems
   2. AC178, Acceptance Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening using Fiber-Reinforced Polymer (FRP) Composite Systems

1.03 MEASUREMENT AND PAYMENT

A. The composite strengthening system shall be bid as a lump sum and is to include all costs associated with the work defined in this specification section. This includes the furnishing of all submittals, materials, tools, equipment, labor, surface preparation, transportation, storage, and supervision required for the application of the FRP materials.
1.04 SUBMITTALS

A. Manufacturers' Product Data
   2. Technical data sheets for materials to be used.
   3. Safety data sheets (SDS) for each material component.
   4. Installation instructions, including temperature restrictions, moisture limitations, surface preparation methods, curing times, and finish requirements.

B. Calculations and Drawings
   1. Design calculations and shop drawings for the composite system shall be compliant with ACI 440.2R and must be stamped and signed by a professional engineer registered in the state of West Virginia.
   2. Design calculations shall also conform to ACI 562 Equation 5.5.1 that stipulates the strength of the unstrengthened structure must be at least equal to: 1.2D + 0.5L + A_k + 0.2S.
   3. Shop drawings, at a minimum, must detail the necessary surface preparation, composite system to be used, number of layers, locations, end details, primary fiber direction, and finish requirements.

C. Applicator Qualification
   1. Written documentation from the composite system manufacturer that the contractor has completed the manufacturer’s training program and has been trained to install the proposed system.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All products shall be delivered, stored, and handled according to the manufacturer’s recommendations.

B. Materials shall be clearly labeled and delivered in factory-sealed containers with manufacturing dates and shelf lives easily identifiable.

C. Materials shall be stored in a protected area free of moisture and UV exposure, with temperatures between 45°F and 95°F.

PART 2 PRODUCTS

2.01 COMPOSITE STRENGTHENING SYSTEM

A. Composite Strengthening System™ supplied by Simpson Strong-Tie®, Inc.

B. Composite Fiberwrap™ supplied by Delta Structural Technology, LLC

C. V-Wrap Systems™ supplied by Structural Technologies

D. CFRP Strengthening Systems by Sika Corporation®
PART 3  EXECUTION OF WORK

3.01 SURFACE PREPARATION

A. Surfaces to be wrapped shall be clean, sound, and free of standing water at time of application. All dust, laitance, grease, curing compounds, and other foreign materials that may hinder the bond must be removed before installation.

B. Existing concave and convex surfaces to be filled/transitional with epoxy paste or a suitable repair mortar.

C. The concrete shall be abrasively prepared as required to achieve the desired surface texture as recommended by the carbon fiber reinforcing supplier. Possible means may include grinding, sand blasting, shot blasting, or pressure washing unless the FRP is being applied in a contact-critical application (i.e. horizontal wrapping of columns).

D. Any corners to be wrapped around shall be rounded to a ¾ inch minimum radius using a grinder or filler epoxy.

3.02 SURFACE MOUNTED APPLICATION

A. Verify ambient and concrete surface temperatures are between 45°F and 95°F or as recommended by the composite manufacturer.

B. Apply surface primer using a nap roller or as recommended by the composite manufacturer when using fabrics.

C. Apply epoxy paste where minor surface defects are present.

D. Allow the primer and/or paste to become tacky to the touch before applying the saturated fabric or pasted laminate or as recommended by the composite manufacturer.

E. When manually saturating fabric, precut sheets to required length using heavy duty shears before saturating with hand rollers. If mechanically saturating fabric with rollers, cut sheets using heavy duty shears either before or after they go through the epoxy bath. In both cases, ensure full fabric saturation is achieved. When precured laminates are used, cut to required length using a metal cutting wheel, clean with solvent, and apply paste to laminate per manufacturer's recommendations.

F. Apply the saturated sheet or pasted laminate to the installation surface and remove entrapped air using hand pressure, rollers, or trowels per manufacturer's recommendations.

G. When using fabrics, apply additional layers as necessary to meet the project requirements, ensuring each layer is firmly adhered to the previous layer. When using laminates, do not apply more than one layer.

H. Feather all fabric seams/edges with epoxy paste per manufacturer's recommendations.
I. Confirm that intimate contact between composite system and substrate will be maintained throughout the curing process.

J. Apply finish coating after full epoxy cure, lightly sanding epoxy surfaces before installation per manufacturer’s recommendations.

3.03 QUALITY CONTROL

A. Field Monitoring
   1. The work performed in Section 3.1 and Section 3.2 of this specification will be field monitored by the Owner’s Special Inspection Agency. The surface preparation shall be checked immediately before application of the composite system materials. Periodic inspection shall be provided during the application process.
   2. The special inspector shall create daily reports that document the following:
      a) Date and time of installation.
      b) Ambient temperature, relative humidity, and weather conditions.
      c) Substrate surface temperature and dryness.
      d) Surface preparation method and ICRI concrete surface profile.
      e) Surface cleanliness description.
      f) Fabric/laminate/FRP anchor batch numbers.
      g) Epoxy batch numbers, mix ratios, and mixing times.
      h) Application locations.
      i) Conformance with installation procedures.
      j) Location and size of any delaminations/voids identified or repaired.
   3. For fabric systems, the contractor shall create a minimum of two material sample sets daily. Each set will consist of two 12 in. by 12 in. panels made of two layers of saturated fabric and the sets shall be taken at different times during the working shift so that it is representative of maximum variances in material/site conditions. Prepare samples on a flat, level surface covered with heavy-duty vinyl (or similar). Prime vinyl with epoxy saturant, place saturated layers, and apply a top coat of epoxy saturant. Samples shall be cured at the site under the same environmental conditions as the production work they represent and must be marked with sample date, time, epoxy/fabric batch numbers, and installation locations.

B. Field Testing
   1. Adhesion Tests
      a. Pull-off tests shall be conducted in accordance with ASTM D7522 and/or ASTM D4541 and performed on flat surfaces. 3 tests shall be executed on each type of substrate or surface preparation method used, with a minimum of 3 tests per 1000 square feet of surface area covered. Testing shall be done on an area adjacent to strengthening locations with substrate, surface preparation, and orientation (i.e. overhead, vertical, etc.) that are representative of that being strengthened. Before pull-off tests are performed, the composite system shall be allowed to reach full cure.
      b. Adhesion strengths shall be in excess of 200 psi or as established by the supplier’s design engineer.
C. Lab Testing
   1. Tension Tests
      a. General
         1) Lab tension tests are only required when structural
            performance criteria is specified.
         2) Tension tests shall be performed to verify the tensile
            strength, strain, and modulus of the composite
            strengthening system based on the nominal layer
            thickness reported on the manufacturer’s data sheet and
            used in the design calculations.
         3) The composite tensile properties used in the design
            calculations must be lower than the average of the test
            results unless calculations are performed with the reported
            average tensile properties show that the strengthening
            requirements are satisfied.
   2. Fabric Systems
      a. One panel from a minimum of 15% of all sample sets shall be
         selected for tension testing performed in accordance with ASTM
         D7565 and/or ASTM D3039.
   3. Laminate Systems
      a. For each laminate batch, tension testing of five coupons shall be
         performed in accordance with ASTM D7565 and/or ASTM D3039.

D. Defects
   1. Small delaminations less than 2 square inches are acceptable so long as
      the delaminated area is less than 5% of the total laminate area and there
      are no more than 10 such delaminations per 10 square feet.
   2. Large delaminations greater than 25 square inches shall be locally cut
      away and a new material shall be applied with an equivalent number of
      layers and sufficient development length overlaps.
   3. Delaminations between 2 square inches and 25 square inches shall be
      injected with epoxy or replaced, depending on the size, number of
      delaminations, and locations.

E. Remedial Measures
   1. If the composite tensile properties used in the design calculations are
      higher than the average of the laboratory test results, design calculations
      shall be resubmitted, showing that the target design performance has been
      achieved. If this is not the case, additional layers shall be applied until the
      target design performance is reached.

END OF SECTION
SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1  GENERAL

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

1.02  RELATED REQUIREMENTS
A. Section 03 20 00 - Concrete Reinforcing.
B. Section 03 30 00 - Cast-in-Place Concrete.

1.03  REFERENCE STANDARDS
B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute.
C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute.
D. ACI 347 - Guide to Formwork for Concrete; American Concrete Institute.

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

1.05  QUALITY ASSURANCE
A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in Tennessee.
B. Maintain one copy of each installation standard on-site throughout the duration of concrete work.

**PART 2  PRODUCTS**

2.01  **FORMWORK - GENERAL**

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.

C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

D. Comply with relevant portions of ACI 347, ACI 301, and ACI 318.

2.02  **WOOD FORM MATERIALS**

A. Form Materials: At the discretion of the Contractor.

2.03  **FORMWORK ACCESSORIES**

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

B. Form Release Agent: Colorless mineral oil that will not stain concrete.

C. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

D. Flashing Reglets: Galvanized steel, 22 gage thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

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

F. Waterstops: Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, 6-inch-wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.
**PART 3  EXECUTION**

3.01  EXAMINATION

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

3.02  ERECTION - FORMWORK

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

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

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

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

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

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

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

3.03  APPLICATION - FORM RELEASE AGENT

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

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.04  INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.
C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.05 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

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

3.06 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117.

B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

3.07 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
3.08 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION
SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

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

1.02 RELATED REQUIREMENTS
A. Section 03 10 00 - Concrete Forming and Accessories.
B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS
A. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
C. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 REINFORCEMENT
A. Reinforcing Steel: ASTM A615/A615M Grade 60 (420).
   1. Deformed billet-steel bars.
   2. Unfinished, unless otherwise indicated.
B. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, deformed type.
   1. Coiled Rolls or Flat Sheets.
C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage.
   2. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic-coated steel components for placement within 1-1/2 inches of weathering surfaces.
2.02 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is not permitted.

C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
   1. Review locations of splices with Engineer of Record.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor barrier.

C. Accommodate placement of formed openings.

D. Conform to applicable code for concrete cover over reinforcement.

E. Bond and ground all reinforcement to requirements of Section 260526.

F. Clean reinforcement of loose rust and mill scale.

G. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. At lap splices, lap a minimum of 2 squares. Secure lap splices with metal tie wire.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 014000, will inspect installed reinforcement for conformance to contract documents before concrete placement.

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

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete footings.
B. Concrete building frame members.
C. Elevated concrete slabs.
D. Floors and slabs on grade.
E. Concrete walls.
F. Joint devices associated with concrete work.
G. Miscellaneous concrete elements, including equipment pads.
H. Concrete curing.

1.02 RELATED SECTIONS

A. Section 03 10 00 - Concrete Forming and Accessories
B. Section 03 20 00 - Concrete Reinforcement
C. Section 07 92 00 - Joint Sealers.

1.03 REFERENCES

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute International.
B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International.
C. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International.
D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International.
E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International.
F. ACI 305R - Hot Weather Concreting; American Concrete Institute International.
G. ACI 306R - Cold Weather Concreting; American Concrete Institute International.
H. ACI 308R - Guide to Curing Concrete; American Concrete Institute International.
I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International.
J. ACI 347 - Guide to Formwork for Concrete; American Concrete Institute International.
K. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
L. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
S. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
W. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
Z. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-
Cement Grout (Nonshrink).

AA. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).


AC. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers.

AD. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers [Metric].

AE. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

AF. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop; Corps of Engineers.

1.04 SUBMITTALS

A. See Section 00 13 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers’ data on manufactured products showing compliance with specified requirements.

C. Mix Designs: Submit mix designs complying with the requirements of ACI 301 Section 4 - Concrete Mixtures, and ACI Chapter 5 - Concrete Quality, Mixing, and Placing.

C. Samples: Submit samples of underslab vapor retarder to be used.

D. Samples: Submit two, 12-inch-long samples of waterstops and construction joint devices.

E. Manufacturer’s Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

F. LEED Data: Use Materials and Resources Form to report materials’ recycled content, local/regional content, and cost for MR Credits 4 & 5 per Section 01 81 13.

H. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
B. Follow recommendations of ACI 305R when concreting during hot weather.
C. Follow recommendations of ACI 306R when concreting during cold weather.

**PART 2 PRODUCTS**

2.01 FORMWORK

A. Refer to Section 03 10 00

2.02 REINFORCEMENT

A. Refer to Section 03 20 00

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal Portland type.
C. Fly Ash: ASTM C618, Class C or F.
D. Water: Clean and not detrimental to concrete.

2.04 CHEMICAL ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
G. Accelerating Admixture: ASTM C494/C494M Type C.
H. Retarding Admixture: ASTM C494/C494M Type B.
I. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Six-mil thick polyethylene vapor retarder beneath slab on grade.
B. Chemical Hardener: Fluosilicate solution designed for densification of cured concrete slabs.

C. Non-Shrink Grout: ASTM C1107/C1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,400 psi.
   2. Minimum Compressive Strength at 28 Days: 7,000 psi.

D. Moisture-Retaining Cover: ASTM C171; regular curing paper, white curing paper, clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.

E. Liquid Curing Compound: ASTM C309, Type 1, clear or translucent.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-dispersible acrylic latex, complying with ASTM C1059 Type II.


C. Waterstops: PVC, complying with COE CRD-C 572.
   1. Configuration: As indicated on the drawings.
   2. Size: As indicated on the drawings.

D. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
   1. Size: 1/2-inch throat, 1/2-inch deep.

E. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D1751, 1/4-inch-thick and 4-inches deep; tongue-and-groove profile.

F. Joint Filler: Compressible asphalt mastic with felt facers, complying with ASTM D994, 1/4-inch-thick and 4-inches deep.

G. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with minimum 1-inch-diameter holes for conduit or rebars to pass through at 6 inches on-center; ribbed steel stakes for setting.

2.07 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations. Lightweight Weight Concrete: Comply with ACI 211.2 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete based on field experience or trial mixtures, as specified in ACI 301.
1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

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

D. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
3. Water-Cement Ratio: Maximum 50 percent by weight unless lower maximum value noted on the drawings.
4. Total Air Content: As noted on drawing, determined in accordance with ASTM C173/C 173M.
5. Maximum Slump: 3 inches before addition of high range water reducing admixture.

E. Lightweight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
2. Water-Cement Ratio: Maximum 50 percent by weight unless lower maximum value noted on the drawings.
3. Total Air Content: 4 to 7 percent, determined in accordance with ASTM C173/C 173M.
4. Maximum dry unit weight: 115lb per cubic foot

2.08 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Refer Section 03 10 00

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in
accordance with manufacturer's instructions.
1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
2. Use latex bonding agent only for non-load-bearing applications.

E. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

F. Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches and seal watertight by taping edges and ends. Cover with sand to depth shown on drawings; repair damaged vapor retarder before covering.

3.03 INSTALLING REINFORCEMENT

A. Refer Section 03 20 00

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect not less than 24 hours prior to commencement of placement operations.

D. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

E. Repair underslab vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

F. Separate slabs on grade from vertical surfaces with joint filler.

G. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

H. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface. Conform to Section 07 90 00 for finish joint sealer requirements.

I. Install joint devices in accordance with manufacturer's instructions.

J. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

K. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

L. Place concrete continuously between predetermined expansion, control, and
construction joints.

M. Do not interrupt successive placement; do not permit cold joints to occur.

N. Place floor slabs in checkerboard or saw cut pattern indicated.

O. Saw cut joints within 24 hours after placing. Use 3/16-inch-thick blade, cut into 1/4 depth of slab thickness.

P. Screed floors level, maintaining the following minimum F(F) Floor Flatness and F(L) Floor Levelness values when measured in accordance with ASTM E1155/ASTM E1155M.
   1. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
   2. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for formwork supported suspended slabs measured prior to removal of formwork. Elevated slabs cast on metal deck shall conform to the specified flatness criteria.

3.05 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
   1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
   2. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Wood float surfaces that will receive quarry tile, ceramic tile, and terrazzo with full bed setting system.
   2. Steel trowel surfaces that will receive carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
   3. Steel trowel surfaces that will be left exposed.
      a. Chemical Hardener: After slab has cured, apply water-diluted hardener in three coats per manufacturer’s instructions, allowing 24 hours between coats.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.06 CURING AND PROTECTION
A. Comply with requirements of ACI 308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than 7 days.

C. Surfaces Not in Contact with Forms:
   1. Start initial curing as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
   2. Begin final curing after initial curing but before surface is dry.
      a. Moisture-retaining cover: Seal in place with waterproof tape or adhesive.
      b. Curing compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.07 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100-cubic yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold-weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.08 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

END OF SECTION
SECTION 03 33 00
CAST-IN-PLACE ARCHITECTURAL CONCRETE

PART 1  GENERAL

1.01 SUMMARY

A. This Section specifies cast-in-place architectural concrete, including formwork, form facings, reinforcement accessories, concrete materials, concrete mix design, placement procedures and finishes.

1.02 RELATED SECTIONS

A. Cast-in-Place Concrete (Structural): Section 03 30 00.

B. Joint Sealants: Section 07 92 00.

1.03 DEFINITION

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of the completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. 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.


1.04 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie location and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

D. Samples: For each of the following materials:
   1. Form-facing panel.
   2. Form-release agent.
   3. Form ties and cones.
5. Coarse- and fine-aggregate gradations.
6. Chamfers and rustications.
7. Curing compound.

E. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18 by 18 by 2 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced concrete contractor who has specialized in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment. Manufacturer must be certified according to the National Ready Mixed Concrete Association's "Certification of Ready Mixed Concrete Production Facilities."

C. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mix from one manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

D. ACI Standards: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 117, Specifications for Tolerances for Concrete Construction and Materials
   2. ACI 301, "Specification for Structural Concrete"
   3. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete"

E. Field Sample Panels: After approval of verification sample, before casting architectural concrete, produce sample panels to demonstrate the approved range of selections made under sample Submittals. Produce a minimum of 3 sets of full-scale sample panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.
   1. Locate panels as indicated or, if not indicated, as directed by Architect.
   2. Demonstrate methods of curing aggregate exposure, sealers, and coatings, as applicable.
   3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
   4. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
   5. Demolish and remove sample panels when directed.

F. Concrete Testing Service: Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
G. Mockups: Before casting architectural concrete, build mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
3. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. 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 architectural concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.

PART 2 PRODUCTS

2.01 FORM-FACING MATERIALS

A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will provide 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.

1. Furnish in largest practicable sizes to minimize number of joints.

C. Form Liners: Units of face design, texture, arrangement, and configuration to match design reference sample. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.
D. Rustication Strips: Metal, rigid plastic or dressed wood with sides beveled and back kerfed; nonstaining; in longest practicable lengths.

E. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch, minimum; nonstaining.

F. Form Joint Tape: Compressible foam tape, pressure sensitive, AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch thick.

G. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or S, Grade NS, that adheres to form joint substrates.

H. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration from wood of set-retarding chemicals.

I. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces. Formulate form-release agent with rust inhibitor for steel form-facing materials.

J. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Provide internally disconnecting ties that will leave no metal closer than 1-1/2 inches from the architectural concrete surface.
   2. Provide glass-fiber-reinforced plastic ties, not less than 1/2 inch in diameter, of color selected by Architect from manufacturer’s full range.

2.02 REINFORCEMENT ACCESSORIES

A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Where legs of wire bar supports contact forms, use gray, CRSI Class 1 plastic-protected bar supports.

2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I/II, gray color, of same type, brand, and source for entire Project.
   1. Fly Ash: ASTM C618, Class C or F.

B. Normal-Weight Coarse Aggregate: ASTM C33, from the same source for entire Project with documented service record data of at least 10 years’ satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials, and as follows:
   1. Weathering Region and Class: Moderate, 5M.
   2. Nominal Maximum Aggregate Size: 1 inch.
C. Normal-Weight Fine Aggregate: ASTM C33, manufactured or natural sand, from the same source for entire Project.

D. Water: Potable, complying with ASTM C94 except free of wash water from mixer washout operations.

2.04 ADMIXTURES


B. Chemical Admixtures: Certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C494, Type A.
   2. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
   3. Water-Reducing and Accelerating Admixture: ASTM C494, Type E.
   4. Water-Reducing and Retarding Admixture: ASTM C494, Type D.

2.05 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.06 REPAIR MATERIALS

A. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy-Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.07 CONCRETE MIXES

A. Prepare design mixes for each type and strength of cast-in-place architectural concrete determined by either laboratory trial mix or field test data bases. Proportion concrete according to ACI 211.1 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed concrete mix designs for the laboratory trial mix basis.

C. Proportion concrete mix as follows:
   2. Maximum Water-Cementitious Materials Ratio: 0.46.
3. Maximum Slump: 3 inches.

4. Maximum Slump for Concrete Containing High-Range, Water-Reducing Admixture: 8 inches after admixture is added to concrete with 2- to 4-inch slump.

D. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

2.07 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver cast-in-place architectural concrete according to ASTM C94, and furnish batch ticket information.
   1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
   2. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 90 to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 FORMWORK

A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.

B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

C. In addition to ACI 303.1 limits on form-facing panel deflection, limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class A, 1/8 inch.

D. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
   1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
   2. Do not use rust-stained, steel, form-facing material.

D. 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.
E. Chamfer exterior corners and edges of cast-in-place architectural concrete as
detailed.

F. Coat contact surfaces of wood rustICATIONS and chamfer strips with sealer before
placing reinforcement, anchoring devices, and embedded items.

G. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds,
and bulkheads required in the Work. Determine sizes and locations from trades
providing such items.

H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood,
sawdust, dirt, and other debris just before placing concrete.

I. Seal form joints and penetrations at form ties with form joint tape or form joint
sealant to prevent mortar leaks.

J. Retighten forms and bracing before placing concrete, as required, to prevent
mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to
manufacturer's written instructions, before placing reinforcement.

L. Place form liners accurately to provide finished surface texture indicated.
Provide solid backing and attach securely to prevent deflection and maintain
stability of liners during concreting. Prevent form liners from sagging and
stretching in hot weather. Seal joints of form liners and form liner accessories to

3.02 REINFORCEMENT AND INSERTS

A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for fabricating
and installing steel reinforcement.

B. Set wire ties with ends directed into concrete, not toward exposed concrete
surfaces.

3.03 REMOVING AND REUSING FORMS

A. Formwork 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,
provided concrete is hard enough to not be damaged by form-removal operations
and provided curing and protection operations are maintained.
1. Schedule form removal to maintain surface appearance that matches
approved sample panels.

B. Clean and repair surfaces of forms to be reused in the Work. Do not use split,
frayed, delaminated, or otherwise damaged form-facing material. 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 architectural concrete surfaces.
3.04  JOINTS

A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete 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.

2. Use bulkhead forms with keys of plywood, wood, or expanded galvanized steel sheet, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete. Align construction joint within rustications attached to form-facing material.

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. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.05  CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect.

C. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.

D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

E. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. 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. Do not permit vibrators to contact forms.
F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When air temperature has fallen to or 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 indicated and approved in concrete mix designs.

G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
   1. Cool ingredients before mixing to 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.06 FINISHES, GENERAL

A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
   1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

3.07 AS-CAST FORMED FINISHES

A. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete:
   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.

3.08 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures according to ACI 301 and ACI 306.1.
B. Begin curing immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete 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; use cover material and waterproof tape.

3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.09 FIELD QUALITY CONTROL

A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for field quality-control requirements.

3.10 REPAIRS, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
   1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.

B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

E. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
   1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION
SECTION 03 35 20

COLORED CONCRETE STAIN FINISH

PART 1  GENERAL

1.01  WORK INCLUDED

A. Work of this section includes providing colored stain finish to new concrete floor as indicated on the drawings. Work also includes:
   1. Coordination of work with placement of concrete slab-on-grade specified in Section 03 30 00.
   2. Preparation of concrete substrates.
   3. Colored stain finish.
   4. Finish sealer; provide non-slip type where indicated.

1.02  RELATED SECTIONS

A. Cast-In-Place Concrete: Section 03 30 00.

1.03  SUBMITTALS

A. Product Data: Submit for all items.

B. Samples: Submit 18" x 18" samples of each color required.
   1. When requested by the Architect, and to enable the Architect to determine the formula for each of the colors, provide an average of three samples for each color mix. Include with the samples the mix percentages and adjustments made to the mix since the previous submittal. Architect will designate a maximum of one mix for each of the colors.
   2. Submit samples on concrete substrate; plywood or similar material not permitted.

C. Submit manufacturer's installation, finishing, protection and maintenance instructions.

1.04  QUALITY CONTROL

A. Mock-Up: Apply each coating color on a 6 square foot area in a location designated by Architect to evaluate preparation, priming, adhesion, and coating application. Obtain Architect's approval of appearance before proceeding. When approved, sample panel shall be used as a basis of quality of the finished work.

B. Manufacturer Qualifications: Company regularly engaged in manufacturing and marketing of products specified in this section.

C. Installer Qualifications: Approved and certified by the system manufacturer as qualified installer. Must have performed a minimum of three projects similar in size and scope.
### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's undamaged, unopened containers clearly marked with the following information:
   1. Product name and number.
   2. Manufacturer name and contact information.
   3. Component designation.
   4. Product mix ratio.
   5. Material Safety and Data Sheets.

B. Promptly inspect delivered material to verify quantities, conformance to requirements, and undamaged condition.

C. Handle materials using methods that will prevent damage.

D. Store materials in accordance with manufacturer's instructions, keeping seals and labels intact and legible. Maintain temperatures within allowable range. Do not use materials beyond manufacturer's maximum recommended shelf life.

### 1.06 JOB CONDITIONS

A. Coordination Meeting: Prior to placement of concrete slab in areas to receive colored finish, a coordination meeting will be scheduled under Section 03 30 00. Colored finish installer must attend this meeting. See Section 03 30 00. Include coordination of form release agent during scheduled meeting.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURER

A. Basis of Design: Material make-up and colorings are based on Lithochrome Chemstain by L. M. SCOFIELD.

B. Other Manufacturers: Concrete staining systems by KEMIKO, SOLOMON COLORS and other manufacturers will be considered if materials meet the requirements of the Basis of Design and the texture and colors are an acceptable match as approved by the Architect prior to bid opening. Additionally approved manufacturers will be included by Addendum. An unacceptable texture or color match is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.

#### 2.02 MATERIALS

A. Coloring Material – Floor Applications
   1. Type: Acidic, water based solution of metallic salts that penetrate and react with chemicals in cured concrete.
   2. Application Rate: As recommended by manufacturer; determined by concrete density for colors selected by Architect.
   3. Colors: As selected by Architect. Colors to be determined by samples prepared and submitted to Architect by manufacturer.
B. Sealer
   1. Type: Clear, water-based type compatible with and recommended by
      coloring material manufacturer.
   2. Manufacturer: Cementone Clear Sealer by L. M. SCOFIELD or equal by
      other approved stain manufacturers.

**PART 3 EXECUTION**

3.01 PREPARATION
   A. Prepare slab and vertical surfaces as recommended by manufacturer. Ensure that
      surfaces are free of all dirt, oils, or other materials that could affect the performance
      of the concrete coloring system.
   B. Mechanical Cleaning: Completely remove dirt, wax, grease, oils, curing
      compounds, form release agents, paint or coatings as recommended by coloring
      material manufacturer using an extraction type cleaning system using 200° water
      temperature, 2500 psi minimum to 4500 rpm vacuum motor.
   C. Clean non-moving cracks in substrate as recommended by manufacturer.
   D. Fill spalls and depressions in concrete with cementitious coating as recommended
      by manufacturer.

3.02 PROTECTION OF ADJOINING WORK
   A. Protect adjacent and adjoining work, not scheduled to receive concrete coloring,
      and maintain free from coloring materials.

3.03 FLOOR SUBSTRATE
   A. Coordinate finish of concrete slab with Section 03 30 00. Concrete designated to
      receive coloring material to have a floated and steel troweled finish as required to
      produce a uniform, tight surface. (Steel power troweling to a burnished, hard
      finish is not acceptable.)
   B. Layout and sawcut control joints to layout indicated on the drawings. All sawcuts to
      be true, square and to a tolerance of 1/8” in 10’ with layout lines. Provide ¼” wide
      sawcuts.
   C. Prepare concrete per manufacturer’s requirements.

3.04 STAIN AND SEALANT APPLICATION
   A. Apply coloring materials to the areas indicated on the drawings. Use color ratios
      and mixes to match the submittal samples and mock-ups as approved by the
      Architect.
   B. Seal completed floor and vertical surfaces as recommended by concrete coloring
      system manufacturer.
3.05 PROTECTION AND FINAL CLEANING

A. Protect colored flooring from damage and wear during construction operations.

B. Where temporary cover is required for this purpose comply with manufacturer's recommendations for protective materials and the method of their application. Remove temporary covering just prior to cleaning for final inspection.

1. Protection shall consist of plastic sheeting, taped firmly together, and applied over colored areas plus plywood panels laid over plastic sheeting. Tape seal plywood joints.
2. Clean colored concrete areas of all dirt, spills, grit and other deleterious materials prior to placement of plastic sheeting.

C. Clean flooring just prior to final inspections. Use materials and procedures recommended by coloring material manufacturer.

END OF SECTION
SECTION 04 01 21

MASONRY RESTORATION AND CLEANING

PART 1  GENERAL

1.01  WORK INCLUDED

A. Repoint existing building brick and stone mortar joints in areas indicated on the drawings and clean building as specified herein.

B. Work included

1. Removal of existing loose, deteriorating and scaling mortar, surface preparation of joint and repointing.
2. Cut out mortar joints on inside of parapet wall.
3. Cut out and (re)seal all stress cracks.
4. Cut out, remove and replace existing brick to brick, stone to stone, brick to stone, stone to metal and brick to metal, and reseal with specified material.
5. Complete cleaning of brick, stone and concrete on all elevations, including sills, parapet caps and backs of parapets.
6. In place samples for mortar, brick, stone and sealant color harmony, soundness and workmanship comparisons with existing.
7. Replace missing, broken or spalled brick.
8. Coordinate and sequence masonry restoration work and cleaning work as required for project conditions.

1.02  RELATED SECTIONS

A. Stone items salvaged for reuse: Sections 02 41 19 and 04 00 00.
B. Limestone: Section 04 43 10. Cast stone ? synthetic stone ?
C. New Masonry Cleaner: Section 04 00 00.

1.03  REFERENCE STANDARDS


1.04  SUBMITTALS

A. Product Data: Provide manufacturer's product data sheets on all products to be used for the work.
B. Applicator Qualifications: Submit qualifications of applicator as previously specified.
C. Environmental Regulations: Describe testing, handling, treatment, containment, collection, transport, disposal, and discharge of hazardous wastes and cleaning effluents. Describe any hazardous materials to be cleaned from substrates. Submit applicable local environmental regulations.
D. Protection: Describe methods for protecting surrounding areas, landscaping, building occupants, pedestrians, vehicles, and non-masonry surfaces during the
work from contact with chemical restoration cleaners, residues, rinse water, fumes, wastes, and cleaning effluents.

E. Surface Preparation: Describe surface preparation to be completed before application of restoration cleaners.

F. Application: Describe application procedures of restoration cleaners.

G. Provide an analysis of the existing mortar to determine the original mortar mix. Provide testing agencies qualifications.

H. Pressure spray or rinse as referenced refers to the following:

Provide a combination of rinsing pressure and water volume by masonry washing equipment generating 400-1000 psi with a water flow rate of 6-8 gallons per minute delivered through a 15-45 degree fan spray tip. Equipment should be adjustable to reduce water flow rate and rinsing pressure as required for controlled cleaning of more sensitive surfaces. Refer to the Product Data Sheet for each cleaner for guidelines. Select areas where panels and brick are to be removed and use these materials for the testing of chemicals and pressures; prior to the cleaning of similar surfaces to remain.

1.05 QUALITY ASSURANCE

A. Certification of Experience

1. Work to be performed by experienced and skilled mechanics.
2. Submit evidence or certification that restoration personnel have a minimum of ten (10) consecutive years' experience in this type of work.
3. Evidence or certification of experience shall be in letter form, in addition to statement of experience, and shall contain a list of at least five projects of comparable size and complexity which have been satisfactorily completed.
4. Provide a statement that the work will be under the direct supervision of skilled mechanics.

B. Intent of the work under this section is: replace deteriorated or missing masonry units and joints, repair cracks in masonry, seal around masonry openings to produce as an end result, weather tight walls; clean all existing masonry; to perform work in such a manner that the building appearance will not be marred by unsightly work; and that all necessary precautions are taken to protect exterior and interior of building and surrounding landscaping and traffic areas.

C. Owner reserves the right to perform quality tests on materials used or scheduled to be used in the project; cost of testing shall be borne by the Owner. If testing proves material in question is faulty, Contractor shall bear testing costs for that material.

D. Pre-Application Meeting: Convene a pre-application meeting 2 weeks before the start of exterior masonry restoration cleaning. Require attendance of parties directly affecting work of this section, including the Contractor, Architect, applicator, and cleaning materials MFR's representative. Review environmental regulations, test panel procedures, protection of surrounding areas and non-masonry surfaces, surface preparation, application, and coordination with other work.
E. Sample Area - Repointing

1. Perform repointing operations in a sample area approximately 4' x 6' where approved by Architect.
2. Sample area shall include materials, methods, and all other details of construction that will be used in the completed work.
3. Sample area will be an actual location of the work requiring repointing work and if acceptable to Architect, will remain in place.
4. Perform additional sample area work as required by Architect until a sample area is found to be acceptable.
5. Do not begin repointing operations until the sample area is approved by the Architect.
6. Acceptable sample area will be used as a reference standard for the remaining work.

F. Sample Area - Cleaning

1. Before full-scale application, review manufacturer's product data sheets to determine the suitability of each product for the specific surfaces. Apply each restoration cleaner to test panels to determine dilution rates, dwell times, number of applications, compatibility, effectiveness, application procedures, effects of pressure rinsing, and desired results.
2. Apply restoration cleaners to test panels in accordance with manufacturer's instructions. Allow 48 hours or until test panels are thoroughly dry, before evaluating final appearance and results. Do not begin full-scale application until test panels are inspected and approved by the Architect.
   a. Size: Minimum 4 feet by 4 feet each.
   b. Locations: As determined by the Architect. At least one of the cleaning test panel areas shall be the same area as one of the sample repointing areas. This common test area shall expose mortar aggregate to determine final mortar color.
   c. Restoration Cleaners: Number of test panels as required to completely test each restoration cleaner with each type of substrate and with each type of material or stain to be cleaned.
3. Test all cleaning effluents generated by the restoration cleaning of the test panels to determine any hazardous characteristics. Comply with applicable federal, state, and local environmental regulations regarding testing, handling, treatment, containment, collection, transport, disposal, and discharge of hazardous wastes.
4. Retain and protect approved test panels in undisturbed condition during the work of this section, as standards for judging the restoration cleaning work.

G. Material Test Reports: From a qualified testing agency indicating and interpreting test results of existing mortar analysis. Testing agency and qualifications must be approved by Architect. Refer to 2.02.J for additional testing requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original unopened containers.

B. Store materials off the ground, under cover and protected from weather damage.

C. Stockpile/store aggregates (sand) to prevent contamination from foreign materials.
D. Locate storage areas where they will not be disturbed or damaged by construction operations.

E. Store cleaning material containers upright in a cool, dry, well ventilated place, out of the sun. Store away from all other chemicals and potential sources of contamination. Keep lights, fire, sparks, and heat away from containers. Do not drop onto or slide across sharp objects. Keep containers tightly closed when not in use. Store and handle materials in accordance with manufacturer's instructions.

1.07 PROJECT CONDITIONS

A. Do not clean masonry surfaces when temperatures are below freezing or will be overnight, to avoid harm to masonry. Clean masonry surfaces only when air and masonry surface temperatures are 40° F and above. Allow adequate time for masonry to thaw if freezing conditions exist prior to application.

1.08 ENVIRONMENTAL REGULATIONS

A. Comply with applicable federal, state, and local environmental regulations regarding testing, handling, treatment, containment, collection, transport, disposal, and discharge of hazardous wastes and cleaning effluents.

PART 2 PRODUCTS

2.01 MORTAR

A. General: Contractor shall engage a qualified testing agency. Mortar shall closely match existing surrounding mortar in texture, color and strength as determined by analysis of existing mortar and as approved by the Architect. Analysis shall include types and proportions of cements, lime, aggregates and admixtures used in existing samples. Color match may require adding lime proof mineral colors to give an aged appearance to mortar. Texture match may require the addition of an amount of small aggregates to the mortar mix. Provide non-staining type.

B. Materials

3. Hydrated Lime: ASTM C207, Type S.
4. Aggregate
   a. Mason's Sand (For other than pointing mortar): ASTM C144, clean masonry sand, not over 10% to pass No. 100 sieve for general use.
   b. Silica Sand (for pointing mortar): White or light color, fine pure silica.
5. Water: Clean, fresh and free of deleterious amounts of acids, alkalis and foreign organic matter.
6. Water Repellent Admixture: FORRER INDUSTRIES Dry-Block or Mortar Tite by ADDIMENT. Manufacturer must submit certification that water repellent admixture meets or exceeds requirements specified herein.
   b. Type: Integral polymeric water-repellents (IPWR).
C. Mixes - Unit Masonry

1. Type N Mortar
   a. Proportions: ASTM C270 proportions by volume. Minimum average compressive strength at 28 days of 750 psi. One part Portland cement, one part hydrated lime and six times the sum of the volumes of cement and lime used of damp, loose sand.
   b. Aggregate shall be selected for color and size to closely match existing mortar.

2. Color may be added to the mix in quantities not to exceed 6% by weight of the cement in the mix.

3. Provide samples of aggregates to Architect for approval to incorporate into the mortar mix. Prepare sample mortar mixes using varying amounts of the approved aggregate for submission to and approval by the Architect for color and texture match with existing mortar.

D. Stone Mortar: Provide mix comprised of white and gray cement combined with lime and selected aggregates to produce color matching the color of existing stone mortar. Proportion mix based on analysis of existing mortar as required to match existing in color, texture and strength.

E. Measure cementitious and aggregate material in a dry condition by volume or equivalent weight. Do not measure by shovel, use known measure. Mix materials in a clean mechanical batch mixer.

1. Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again adding only enough water to produce a damp, unworkable mix which will retain its form when pressed into a ball. Maintain mortar in this dampened (prehydrated) condition for 1 to 2 hours. Add remaining water in small portions until desired mortar consistency is reached. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

2.02 CLEANING MATERIALS AND EQUIPMENT

A. Manufacturers: Specifications are based on materials manufactured by PROSOCO, INC. (800-255-4255). Equal or products of similar compounds manufactured by DIETRICH and ARCAL are acceptable.

B. Mild Cleaner: Manufacturer’s standard cleaner and degreaser for light-to-heavy soiled masonry [Red Brick and Iron Spot Brick].
   Basis of Design: "Enviro Klean 2010 All Surface Cleaner": PROSOCO, Inc.

C. Two-Part Cleaner: Manufacturer’s standard two-part system consisting of an alkaline cleaner for prewash and an acid neutralizer for afterwash for dissolving heavy carbon soiling from masonry surfaces. [Dome]
   Basis of Design: "Sure Klean 766 Limestone & Masonry Pre-wash and Sure Klean Limestone & Masonry After-wash": PROSOCO, Inc.

D. Lime Run Remover: Manufacturer’s standard concentrated acidic cleaner to remove atmospheric dirt, mildew, and other stains from unpolished limestone and other high calcium-based surfaces. [Red Brick, Iron Spot Brick and Lime Run]
   Basis of Design: “Sure Klean Limestone Restorer”: PROSOCO, Inc.
E. **Mold, Mildew, and Algae Remover**: Manufacturer's standard two-component system and neutralizer to remove biological and atmospheric staining from masonry. For use on **Limestone Panels, the Dome and Parapet Caps**. 

F. **Rust stains on masonry and lintels**: Lintels should be wire brushed and sanded. If rust remains, remove tough atmospheric soiling and subsurface staining, while minimizing potential for damage to delicate masonry and adjacent substrates; in addition to removing difficult calcium (concrete) stains, white scum and other staining from most window glass. Test stability of surfaces before application. 
   Basis of Design: Sure Klean® Light Duty Restoration Cleaner; PROSOCO, Inc.

G. **Concentrated acidic cleaner for new masonry surfaces** that are subject to vanadium, manganese and other metallic stains, and reduce potential for efflorescence and clean mortar smears  
   Basis of Design: Sure Klean® Vana Trol®: PROSOCO, Inc.

H. **Nonabrasive Brushes**: Fiber bristles only.

I. **Spray Equipment**: Provide equipment for controlled spray application of water and chemical cleaners, if any, at rates indicated for pressure, measured at spray tip, and for volume. Adjust pressure and volume, as required, to ensure that damage to masonry does not result from cleaning methods. For chemical cleaner spray application, provide a low-pressure tank or chemical pump suitable for the chemical cleaner indicated, equipped with a cone-shaped spray tip.

J. Using the same panel selection format as indicated in 1.04.H, test panels to confirm results for all masonry and panel types; for locations where sample panels are undamaged, require minor repair and are new replacements. The samples should reflect all of the conditions that could affect types of cleaners required for the condition, the dwell time and the concentration needed.

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**PART 3 EXECUTION**

3.01 INSPECTION

A. Examine the substrates, structure, and installation conditions.

3.02 PREPARATION - GENERAL

A. Remove or loosen interferences such as cables, conduits, junction boxes, downspouts and railing on the surface of the building which would prevent the accomplishment, or reduce the effectiveness of the work to be performed. Such items shall be reattached, unless the directed otherwise, as work is completed.

B. Adhere to manufacturer's printed instructions and restrictions for applying cleaners.

C. Cover or protect glass, window frames, landscaping and similar items that may be damaged as a result of the work of this section.
D. Protect passerby and vehicular traffic.

3.03 PREPARATION - JOINTS

A. Test rake all mortar joints. Cut out joints found to be defective to a depth of 1/2 inch or to firm mortar, whichever comes first.
   1. Remove dust and loose mortar with compressed air or vacuum. Remove sealant and chemical compounds from joints as required with mechanical and chemical processes that will not abrade or attack the masonry surface.
   2. Defective Joints: Consist of mortar joints in which mortar is soft, loose, missing, severely eroded, flaky, or powdered, broken, hollow or cracked.
   3. It shall be the Contractor's responsibility to carefully examine all wall areas and to see that all defective joints are cut out. Any question as to whether a joint is defective or not shall be resolved to the satisfaction of the Architect.

B. Cut out forced cracks in masonry to a minimum depth of 1/2 inch. Fill void space in masonry larger than specified depth with a non-absorbent closed cell expandable foam back-up. Select a back-up size that will cause compression when in place.

3.04 REPOINTING EXISTING JOINTS

A. Joint Raking
   1. Rake out mortar from joints to firm mortar or to a minimum depth of 1/2 inch, whichever comes first.
   2. Remove mortar from masonry surfaces to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum and/or flush joints to remove dirt and loose debris.
   3. Do not spall edges of masonry units or widen joints. Replace masonry units which become damaged.
      a. Cut out mortar with chisel and mallet, unless otherwise indicated.
      b. Power operated hand saws and grinders will be permitted only with specific written approval of the Architect based on submission of the Contractor of a satisfactory quality control program and demonstrated ability of operators to use tools without damage to masonry. Quality control program shall include provisions for supervising performance and preventing damage due to worker fatigue.

B. Joint Pointing
   1. Clean joint surfaces to remove dust and mortar particles. Schedule water rinsing operations so that, at time of pointing, excess water has evaporated or run off, and joint surfaces are damp but free of standing water.
   2. Apply first layer of pointing mortar to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8” until a uniform depth is formed. Compact each layer thoroughly and allow to become thumbprint-hard before applying next layer.
   3. After joints have been filled to a uniform depth, place remaining mortar in 3 layers with each of first and second layers filling approximately 2/5 of joint depth and third layer the remaining 1/5. Fully compact each layer and allow to become thumbprint hard before applying next layer. Slightly recess the final layer in from face of masonry. Take care not to spread mortar over
edges onto exposed masonry surfaces; or to featheredge mortar.

4. When final layer of mortar is thumbprint-hard, tool joints to match original appearance of joint or appearance of adjacent existing joint. Remove excess mortar from edge of joint by brushing.

3.05 MASONRY AND STONE REMOVAL AND REPLACEMENT

A. Replace missing, eroded, spalled or cracked masonry and stone units. Cut out deteriorated or damaged units, including entire mortar joint around the masonry unit. Install replacement masonry with joints solidly packed with mortar.

1. Remove units by hand using care so as not to damage adjacent masonry.
2. Repoint new joints to comply with requirements for repointing existing masonry.
3. Place masonry units in a full bed of mortar, bottom and sides, laid with a shove joint.

B. Clean excess mortar, splatter and drippings from exterior and interior as work progresses.

3.06 CLEANING

A. Protection

1. Protect surrounding areas, landscaping, building occupants, pedestrians, vehicles, and non-masonry surfaces during the work from contact with chemical restoration cleaners, residues, rinse water, fumes, wastes, and cleaning effluents in accordance with manufacturer's instructions.
2. Clean masonry before installation of replacement windows.
3. Test window glass not specified to be replaced for compatibility with chemical cleaning products to determine required protection.
4. Divert and protect pedestrian and auto traffic.
5. Avoid wind drifting of spray of chemical cleaning products, residues, and rinse water.

B. Surface Preparation: Apply all specified caulking and sealants and allow to cure before chemical cleaning begins.

C. Chemical Cleaners: When permitted for use, apply restoration cleaners to substrates in accordance with manufacturer's instructions, environmental regulations, and application procedures determined from test panel results approved by the Architect. Consult manufacturer's instructions for information on equipment to be used and precautions to be taken with the specified products.

END OF SECTION
PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide the following:
1. Concrete masonry units.
   a. Standard
   b. Fire-rated
2. Masonry lintels, setting of steel angles, setting bearing plates supported and embedded with masonry furnished under Section 05 50 00.
3. Provide masonry fill concrete and reinforcing steel where indicated on drawings. See Section 03 30 00.
4. Wall reinforcing and accessories.
5. Built-in collars, sleeves, inserts, anchors, ties, sockets, bolts, blocking, miscellaneous metal work, etc., in contact with, supported on or enclosed by masonry. When these items are furnished by others, they shall include information for setting.
6. Includes grouting solid all hollow metal door frames in masonry.
7. Mortar and grout.

1.02  DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.03  SUBMITTALS

A. Product Data: For each different masonry unit, accessory and other manufactured products specified.

B. Submit certification that fire resistant concrete units conform to the requirements specified herein for Fire Resistant Concrete Block.

C. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
1. Each type of masonry unit required.
   a. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.
2. Each combination of masonry unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
3. Each material and grade indicated for reinforcing bars.
4. Each type and size of joint reinforcement.

D. Cold-Weather Procedures: Detailed description of methods, materials and equipment to be used to comply with cold-weather requirements.
1.04 QUALITY ASSURANCE

A. Supervisor: A supervisory journeyman mason shall be appointed for the project and shall be present at all times masonry work is being performed and:
1. have minimum of 5 years experience on masonry projects of this type/size
2. be thoroughly familiar with the design requirements, types of materials being installed, referenced standards and other requirements.

B. Use only skilled journeyman masons for cutting and placing of masonry; no allowance shall be made for lack of skill on the part of the workmen.

C. Consult other trades and make provisions that shall permit the installation of their work in a manner to avoid cutting and patching. Build-in work under other sections, as necessary, and as the work progresses.

D. Unit Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602, “Specifications for Masonry Structures”. Maintain one copy of the standard in project field office at all times during construction. Contractor's supervisory personnel shall be thoroughly familiar with the material as it applies to this Project.

E. Concrete Unit Masonry Construction: Comply with the National Concrete Masonry Association (NCMA) “TEK Bulletins”, and other requirements specified.
1. NCMA TEK Bulletin 3-2 “Grouting for Concrete Masonry Walls”.
2. NCMA TEK Bulletin 3-3A “Reinforced Concrete Masonry”.
3. NCMA TEK Bulletin 8-2 “Removal of Stains from Concrete Masonry Walls”.
4. NCMA TEK Bulletin 10-1A “Crack Control in Concrete Masonry Walls”.
5. NCMA TEK Bulletin 10-2B “Control Joints for Concrete Masonry Walls”.
6. NCMA TEK Bulletin 14-2 “Reinforced Concrete Masonry”.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store cement and lime materials and masonry units off the ground, under cover and protected from weather damage. If units become wet, do not install until they are dry. Do not use cementitious materials that have become damp.

B. Stockpile and store aggregates to prevent contamination from foreign materials, in locations where grading and other required characteristics can be maintained.

C. Use care in handling units to avoid chipping and breakage.

D. Locate storage areas where they will not be disturbed or damaged by construction operations.

E. Protect finished floor areas from damage.

1.06 COLD WEATHER CONSTRUCTION

A. Comply with recommended practices for cold weather construction of the International Masonry Industry All-Weather Council and requirements contained in ACI 530.1/ASCE 6/TMS 602.
B. Do not build on frozen or snow covered work. Remove and replace masonry work damaged by frost or freezing.

C. Requirements During Construction: Provide the following minimum requirements for the air temperatures listed:
   1. Above 40° F: Normal masonry procedures.
   2. 40° F to 32° F: Heat mixing water to produce mortar temperatures between 40° F and 120° F. Produce consecutive batches of mortar with the same temperatures within this range. Do not heat mortar to greater than 120° F.
   3. Below 32° F to 25° F: Heat sufficient mortar ingredients to produce mortar temperatures between 40° F and 120° F. Produce consecutive batches of mortar with the same temperatures falling within this range. Maintain mortar temperatures after mixing above 40° F. Do not heat mortar to greater than 120° F.
   4. Below 25° F to 20° F: Heat sufficient mortar ingredients to produce mortar temperatures between 40° F and 120° F. Produce consecutive batches of mortar with the same temperatures falling within this range. Maintain mortar temperatures after mixing above 40° F. Do not heat mortar to greater than 120° F. Maintain masonry above freezing using auxiliary heat. Provide enclosure when wind is in excess of 15 mph.
   5. Below 20° F: Heat sufficient mortar ingredients to produce mortar temperatures between 40° F and 120° F. Produce consecutive batches of mortar with the same temperatures falling within this range. Maintain mortar temperatures after mixing above 40° F. Do not heat mortar to greater than 120° F. Keep masonry above freezing using enclosure and auxiliary heat.

D. Protection Requirements for Completed Masonry (and masonry not being worked on): Provide the following minimum requirements for the mean daily air temperatures listed:
   1. Above 40° F: Normal masonry procedures.
   2. 40° F to 32° F: Protect from rain or snow for 24 hours with weather-resistant membrane.
   3. Below 32° F to 20° F: Completely cover with weather-resistant membrane and maintain above freezing for 24 hours.
   4. Below 20° F: Provide weather-resistant enclosure and auxiliary heat to maintain above freezing for 24 hours.

1.07 HOT WEATHER CONSTRUCTION

A. Protect masonry construction from direct exposure to wind and sun when erected in an ambient air temperature of 90° F., or greater in shade with relative humidity less than 50%. Provide artificial shade and wind breaks and use cooled materials as required. Provide artificial shade, wind breaks, use cooled materials and other procedures outlined in BIA Tech Notes #1.

1.08 PROJECT CONDITIONS

A. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
   1. Brace unsupported and newly laid masonry walls. Maintain bracing in place until building structure provides permanent bracing.
B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar and soil that become in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread 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 on completed masonry.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. General
1. Curing: Cure for at least 7 days and units must be at least 28 days old when used in the work.
2. Color: Natural color.

B. Hollow Load Bearing, Solid Load Bearing (75%) and Fire Resistant Concrete Masonry Units
1. Type: Hollow, load bearing, standard modular size and shapes, thoroughly cured and dried.
2. References: ASTM C90.
3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
4. Weight Classification: Normal weight, unless otherwise indicated.
5. Linear Shrinkage: Not to exceed 0.065 percent, ASTM C426.
7. Fire Resistant
   a. Rating: Design for fire ratings indicated on drawings.
   b. Manufacturer
      1) Listed in the Building Materials List published by the Underwriters' Laboratories, Inc.
      2) In lieu of above, provide a report from a nationally recognized testing agency stating that the units are equivalent in fire rating to those furnished by the producers as listed above.
   c. Location: Where indicated.

2.02 MORTAR

A. Materials
1. Portland Cement: ASTM C150, 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 or selected.
3. Hydrated Lime: ASTM C207, Type S.
4. Aggregate: ASTM C144, clean masonry sand, not over 10% to pass No. 100 sieve for general use.
5. Water: Clean, fresh and free of deleterious amounts of acids, alkalis and foreign organic matter.

B. Proprietary Mortar Cement: Conform to ASTM C91, containing hydrated lime.
   1. Certification: Submit certified laboratory data substantiating conformance with structural requirements for mortars as specified; and that no adverse chemical reaction will occur with the specified masonry accessories and reinforcing. Certification must be received and approved by Architect prior to mortar use.
   2. Suitable products are acceptable from the following manufacturers:
      a. CEMEX (Richcolor)  
      b. LEHIGH PORTLAND CEMENT COMPANY  
      c. ESSROC MATERIALS, INC. (Brixment)  
      d. QUIKRETE

C. Mixes - Unit Masonry
   1. Provide water repellent admixture in all mortar used for exterior masonry work. Add to mix in accordance with manufacturer's recommendations.
   2. Type S Mortar
      a. Proportions: ASTM C270 proportions by volume. Minimum average compressive strength at 28 days of 1,800 psi.
      b. Color: Natural color.

2.03 GROUT

A. Masonry Grout - Mix
   1. Fine Grout for Reinforced Masonry: Mix with mechanical mixer with sufficient water to the desired consistency in accordance with ASTM C476 Proportion Specifications.
      a. Portland Cement: 1 part
      b. Hydrated Lime: 0 to 1/10 part
      c. Fine Aggregate: 2-1/4 to 3 times the sum of the volumes of the cementitious materials
   2. Coarse Grout for Reinforced Masonry: Mix with mechanical mixer with sufficient water to the desired consistency in accordance with ASTM C476 Proportion Specifications.
      a. Portland Cement: 1 part
      b. Hydrated Lime: 0 to 1/10 part
      c. Fine Aggregate: 2-1/4 to 3 times the sum of the volumes of the cementitious materials.
      d. Coarse Aggregate: 1 to 2 times the sum of the volumes of the cementitious materials.
   3. Hand Mixing: Not acceptable.

2.04 REINFORCING

A. Manufacturers: DUR-O-WALL; HECKMANN BUILDING PRODUCTS; HOHMANN & BARNARD; MASONRY REINFORCING CORPORATION OF AMERICA (WIREBOND). Where products are specified referencing a particular manufacturer,
equal products from the manufacturers listed are acceptable providing the product meets the requirements indicated.
1. Where a manufacturer is listed below for a specific product, it is to establish a level of quality. Similar products of equal quality from the above listed manufacturers are acceptable.

B. Horizontal Joint Reinforcement
1. General
   a. Type: Ladder type, standard weight, galvanized.
   b. Width: Approximately 2 in. less than nominal wall thickness.
   c. Spacing: Continuous along horizontal joint, spaced 16 inches on center vertically, unless otherwise indicated.

2. Longitudinal Wire

C. Wire Mesh: Wire Mesh: 1/4" mesh of galvanized steel wire (min. 16 gage) or galvanized metal lath, cut into strips 1-1/2" narrower than wall width where used. For use at intersection of masonry walls and as a grout stop.

D. Reinforcing Steel - Bond Beam [and Wall] Reinforcement: Uncoated steel reinforcing bars; ASTM A615/A; ASTM A616, including Supplement 1; or ASTM A617/A, Grade 60.

**PART 3 EXECUTION**

3.01 INSPECTION
A. Examine the substrates, structure, and installation conditions. Do not proceed with unit masonry work until unsatisfactory conditions are corrected.

3.02 PREPARATION
A. Concrete Masonry Units: Lay masonry units dry. Do not wet masonry units.
B. Establish lines, levels, and coursing.
C. Coordination: Identify items that are to be built-in to masonry wall as specified in other section of these specifications. Verify that these items are available prior to commencing masonry work in these areas. Coordinate sizes of required openings.

3.03 INSTALLATION - GENERAL
A. Build walls to the full thickness shown. Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown or specified.
B. Cut masonry units using motor-driven masonry saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full-size units without cutting wherever possible. Provide 100% solid units where webs would be exposed.
C. Construction Tolerance: Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:
   1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than ¼” in 20 feet, nor ½” maximum.
   2. For vertical alignment of exposed head joints, do not vary from plumb by more than ¼” in 10 feet, nor ½” maximum.
   3. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than ¼” in 20 feet, nor ½” maximum.
   4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8”, with a maximum thickness limited to ½”. Do not vary from bed-joint thickness of adjacent courses by more than 1/8”.
   5. For exposed head joints, do not vary from thickness by more than plus or minus 1/8”. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8”.

D. Openings: Form all chases and openings required for piping and other trades. After work is completed, close openings with masonry and seal around penetration.

3.04 ERECTION - CONCRETE MASONRY

A. Masonry
   1. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths, and to properly locate returns and offsets. Avoid the use of less than half-size units at corners, jambs and other locations.
   2. Lay up walls plumb and true to comply with specified tolerance. Provide courses level, accurately spaced and coordinated with other work.
   3. Pattern Bond: Lay exposed masonry in running bond with vertical joint in each course centered on units in courses above and below. Bond and interlock each course of each wythe at corners. Do not use units with less than 4” of horizontal face dimensions at corners.
   4. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and slabs. Maintain 3/8” joint widths, except for minor variations required to maintain bond alignment.
   5. Joints
      a. Exposed: Cut flush and finish (tool) with hardened metal tool to form a concave compressed joint. Same methods and types of tools to be used by all masons working on project.
      b. Concealed: Cut flush and trowel point.

B. Horizontal Wall Reinforcement: Provide continuous masonry joint reinforcement as indicated. 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. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
      a. Reinforcement above is in addition to continuous reinforcement.
   3. Cut or interrupt joint reinforcement at control and expansion joints, unless...
4. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

5. Provide additional reinforcement continuous in first joint above openings and in first joint below openings not extending to floor. Extend additional reinforcement a minimum of 4'-0" beyond opening.

C. Bond Beams and Block Cores: Reinforce as indicated and fill with grout.
   1. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
   2. Position reinforcement accurately at the spacing indicated. Place horizontal reinforcement as the masonry work progresses.
      a. Use "Fine Grout" per ASTM C 476 for filling spaces less than 4" in one or both horizontal directions.
      b. Use "Coarse Grout" per ASTM C 476 for filling spaces 4" to 10" in both horizontal directions.
      c. Use 3000 psi concrete for filling spaces 10" or larger in both horizontal directions.

D. Door Frames: Fill all frames installed in masonry with mortar.

E. Bearing Points: Where a lintel, beam or similar member bears directly on concrete masonry, fill the cores of the two blocks courses directly under the member with grout to a limit of 16 inches beyond the end of the member.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

G. Control and Expansion Joints: Provide control joints for exterior and interior masonry construction in accordance with NCMA-TEK Bulletins 10-1A and 10-2B.
   1. Unless otherwise indicated, provide control joints in masonry walls at maximum 30 foot intervals for interior walls, and at intersections of walls, except corners.
      a. Exact locations as determined by the Architect if not specifically dimensioned.
      b. If drawings do not indicate all control joints based on these maximums, allow for additional joints to be determined by the Architect prior to commencement of masonry work.
      c. Locate control at steel columns.
   2. Provide 3/8" wide control joints, unless otherwise indicated. For interior control joints, no filler is required; rake joint approximately 3/4" deep and install sealant and backup. See Section 07 92 00, Sealants.
   3. Do not carry horizontal joint reinforcement through control joint.
   4. Maintain lateral support of continuous wall at control joint by using control joint filler, tongue and groove type control joint block, or similar type approved method.
5. Maintain lateral support of intersecting interior masonry walls with wire mesh ties placed across joint between walls, spaced 16" on-center vertically.

H. Masonry, non-bearing walls carried to structure above: Terminate at normal joint width below surface and leave joint open for sealants.
   1. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Section 07 84 00, Firestopping.

I. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, remove loose masonry units and mortar before laying fresh masonry.

J. Built-in Work: As construction progresses, build in items specified under this and other specification sections. Fill in solidly with masonry around built-in items.

K. Steel Lintels: Install steel lintels at all masonry opening, whether indicated on the drawings or not. Provide minimum bearing of 8" an each jamb, unless otherwise indicated.

3.05 MORTAR

A. General
   1. Batch Size: Controlled so that all material used within two (2) hours.
   2. Mortar on Board
      a. Keep well tempered with water so long as its cementing material has not started to set.
      b. Do not retemper if initial set of cementing material has been reached, or if mortar has stiffened greatly.

B. Mixing
   1. Machine mix dry in a batch mixer with care taken in adding water to mix to avoid overwetting.
   2. Do not retamper in mixer at any time.
   3. Continue mixing for a minimum of five (5) minutes after all materials are in mixer.

C. Recharging: Completely empty and clean mixer before recharging.

3.06 PROTECTION

A. Brace all walls while in green condition.

B. Protection of Masonry: During construction, cover tops of walls 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 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.

3.07 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:
   1. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. of wall area or portion thereof.

C. Mortar properties will be tested per ASTM C780.

D. Grout will be sampled and tested for compressive strength per ASTM C1019.

3.08 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged. Provide new units to match adjoining units and install in fresh mortar pointed to eliminate evidence of replacement.

B. During the tooling of joints, enlarge all voids or holes, and completely fill with mortar. Point up all joints at corners to provide a neat, uniform appearance.

C. Cleaning – Concrete Masonry: During construction of exposed CMU, minimize mortar and grout smears on exposed surfaces. Dry brush CMU surfaces at the end of each days work and after final pointing. Remove mortar stains and dirt from exposed surfaces.
   1. Cleaning Solutions: Where cleaning solutions are required, they shall be provided at no additional cost to the Owner. Cleaning solutions must be approved by Architect and spot tested prior to use.

D. Area Cleaning: Clean floors of all mortar droppings, including floor surfaces of accessible chases.

3.09 MASONRY WASTE DISPOSAL

A. Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Disposal as Fill Material: When approved by Geotechnical Engineer, dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 30 00,
Earthwork. All fill material must be approved by Geotechnical Engineer.

3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner’s property.

END OF SECTION
SECTION 04 43 10

LIMESTONE

PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide cut limestone and support system as indicated on the drawings and specified herein for a complete installation. Work includes:
   1. Shapes indicated.
   2. Exterior veneer including fabrication of panels to receive anchoring system.
   3. All sealant work touching limestone.
   4. Accessories to complete the work.
   5. Provide supplementary steel framing as required for installation of limestone.
   6. Connection details.

1.02  RELATED SECTIONS

A. Mortar and Unit Masonry: Section 04 22 00.

B. Joint Sealants: Section 07 92 00.

C. Flashing: Section 07 62 00.

1.03  SUBMITTALS

A. Shop Drawings: Submit for fabrication and erection (installation). Include large scale (1/4 full size) details at anchorage, jointing, support systems, flashing and other accessories.
   1. Include with stone panel shop drawings methods for removal of panels for panel replacement.

B. Manufacturer's Data: Submit, for information only, copies of manufacturers and fabricator's specifications and installation instructions for all materials required, except bolt materials, including certification and laboratory test reports as may be required to show compliance with these specifications. Indicate by transmittal form that a copy of each instruction has been transmitted to installer.

C. Samples - Sealant/Anchor/Flashing Application: Submit to the Architect, adjacent 2" x 12" sample panels showing sealant materials for the Architect's review and selection of jointing materials. Provide sealant joint; typical exterior joint treatment placed between two pieces of selected limestone; anchors for use in mounting limestone; flashings and flashing terminations and joints.

D. Samples: Submit to the Architect, three 12" x 12" samples of the color, grade and finish of limestone required. Acceptable low and high range of variation in grade, color and texture shall be governed by Architect's control samples.
1. In addition to the above, provide adjacent 2" x 12" sample panels showing sealant materials for the Architect's review and selection of jointing materials. Provide sealant joint; typical exterior joint treatment placed between two pieces of selected limestone; anchors for use in mounting limestone; flashings and flashing terminations and joints.

2. Samples shall establish the acceptable range for variation in grade, color, texture and surface finish of limestone which the Contractor proposes to provide. These samples shall be used for comparison purposes during erection, and shall establish the low, average and upper acceptable range of limestone that fall outside of the sample ranges accepted will be rejected. Imperfections such as off color streaks, blotches and "rain drips" that show up through the applied finish will be rejected.

3. Water Table Bands: Submit full size samples of shape that will be utilized in the finished work. Samples of water table band will be used in constructing the sample panel specified in Section 04 00 00.

E. Maintenance Instructions: Submit to Architect fabricator's recommended cleaning and maintenance instructions for the limestone materials being provided.

F. Certification: After review of samples by Architect and prior to fabrication, certify in writing and submit any additional evidence required indicating that a sufficient quantity of materials within the range of accepted materials is available from a single quarry to satisfy the total requirements of the project.

G. Design Calculations: Submit calculations for each type, shape, loading condition and span of limestone units indicated on the drawings, and all related supports and connections. Design of limestone shapes and connections shall be under the direct supervision of a Professional Engineer, registered in the State of Tennessee, and calculations shall bear engineer's seal and signature.

1.04 QUALITY ASSURANCE

A. Stone Fabricator: A firm with a minimum 10 years experience in cutting limestone, which has successfully fabricated cut limestone similar to the quality specified and quantities indicated.

B. Cut Limestone
1. Materials, handling and installation shall comply with Indiana Limestone Institute of America, Inc. (ILI), Indiana Limestone Handbook and as specified herein. In case of conflict, the most stringent requirement applies.
2. All limestone specified or indicated shall be Indiana Oolitic Limestone, as quarried in Lawrence, Monroe and Owen Counties, Indiana.

1.05 PROJECT CONDITIONS

A. Do not install exterior cut stone work, set in mortar, when the outside air temperature is below 40°F. unless suitable means acceptable to the Architect are provided to protect work from cold and frost and ensure that mortar will set without freezing. Comply with International Masonry Industry All-Weather Council recommendations for cold weather construction and protection recommendations.
1. Do not use frozen materials or materials mixed or coated with ice or frost.
2. Do not build on frozen work. Remove and replace work damaged by frost or freezing.

B. Handle stone to prevent chipping, breakage, soiling or other damage. Damaged stones shall be examined by the Architect. Minor repair of stone will be permitted subject to Architect's acceptance. Remove damaged stone, unacceptable to the Architect, from the site.

C. Protect partially completed stone work, when work is not in progress. Cover with waterproof, non-staining membrane; secured in place.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect stone against moisture, soiling, staining and physical damage.

B. Protect edges with wood or other rigid materials. Lift with wide belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances which may cause staining.

C. Store on wood skids or pallets, covered with non-staining, waterproof membrane or enclosure of type that allows air to circulate around stones.

D. Protect mortar and accessories from weather, moisture and contamination with earth and other foreign materials.

PART 2 PRODUCTS

2.01 LIMESTONE MATERIALS

A. Limestone: Indiana (Oolitic) limestone complying with ASTM C568, Category II (medium density) with physical characteristics specified.
   1. Absorption: ASTM C97, 7.5% maximum.
   2. Compressive Strength: ASTM C170, 4,000 psi minimum.

B. Provide fine grade limestone with smooth finish, buff and gray color range, as selected by Architect.

C. Obtain limestone from one quarry. Colors and textures shall be within the range of variations represented by accepted samples. Natural variations in color and markings which are characteristic of the stone and which do not impair strength or appearance will be permitted. Provide only sound stone, free from mineral stains or other foreign matter.

2.02 STONE ANCHORING SYSTEM

A. Size, quantity and spacing as designed by curtainwall fabricator. Design of system has been based on a Kerf anchoring system.
   1. Material
a. Anchor Bolts, Nuts and Washers: Type 304 stainless steel.
b. Shapes, Plates and Rods: Stainless steel, ASTM A167 Type 302B and A276 Type 304.
3. Limestone anchors must have epoxy cement applied into drilled limestone holes. Submit technical data of epoxy cement for Architect's approval.

2.03 SEALANTS AND JOINT FILLERS

A. Joint Sealants: Comply with Section 07 92 00 requirements and specifically recommended by the manufacturer for cut stone pointing. Color compatible with materials sealed and selected by the Architect.

B. Joint Filler: Non-staining, closed cell polyethylene foam complying with Section 07 92 00 requirements.

2.04 ACCESSORIES

A. Expansion Anchors: Type, size and load capacity required to support loading involved.
   1. For anchoring into concrete or concrete filled masonry: Cadmium plated or hot-dipped galvanized steel.
   2. For anchoring into stone: AISI type 302/304 stainless steel.

B. Anchor Bolts, Nuts and Washers: AISI type 302/304 stainless steel if in contact with stone; otherwise provide ASTM A307 low carbon steel type, with ASTM A153 hot-dipped galvanizing.

C. Stone Anchors: Stainless Steel AISI type 302/304 of type and size determined by fabricator to provide permanent anchorage.

D. Setting Buttons and Shims: Stainless steel of thickness required for joint size required and of size required to maintain uniform joint width.

E. Dampproofing: Non-staining cement-base masonry dampproofing compound as recommended by Indiana Limestone Institute.

2.05 FABRICATION

A. Fabricate stone work in accordance with recommendations of the Indiana Limestone Institute (ILI).

B. Cut accurately to shape and dimensions indicated accepted on final shop drawings maintaining fabrication tolerances of ILI.

C. Cut Stone: Dress joints, bed and vertical, straight and at 90° angle to face.
   1. Joint Width: Cut to allow uniform 3/8" joints.
   2. Provide drips and washes as indicated.
   3. Thickness: Provide thickness indicated. Saw-cut back surfaces concealed; in the finish work.
4. Jointing: Provide jointing in accordance with industry standard practice and accepted on shop drawings.
5. Provide holes drilled for anchors, as indicated and as necessary to secure stonework in place.

PART 3 EXECUTION

3.01 CONDITION OF SURFACES

A. Prior to installation, examine surfaces to receive stone and do not proceed until defects detrimental to the finished work in appearance, watertightness or integrity of the completed installation are corrected, including the moisture protection, structural supports, provisions for expansion, or other conditions which might affect the finished work in appearance, watertightness or integrity of the completed installation.

B. Verify all measurements and dimensions; coordinate the installation of inserts for this work, and, coordinate and schedule this work with the work of other trades. Give particular attention to the location and size of cutouts required to accommodate mechanical, electrical and other work or adjoining construction, in accordance with the reviewed shop drawings for such trade.

C. Review shop drawings of items or assemblies related to the support or anchorage of stonework, including requirements for clearances for proper installation.

D. Confirm with the respective manufacturers of all proprietary products (sealants and anchorage devices) that the materials are proper for the expected use and exposure of stonework. No materials soluble in water after setting shall be used.

3.02 PREPARATION

A. When necessary, prior to setting, clean stone thoroughly on all sides by brushing with water and soap powder, followed by a thorough rinsing with clear water.

B. Dampproof backs, bonding faces and surfaces below grade. Allow material to cure as recommended by dampproofing manufacturer.
   1. Eliminate dampproofing at areas to receive sealant.

C. Do not use stone with chips, cracks, voids, stains or other defects which would be visible in the finished work. The setting of any damaged or defective stone is at Contractor's risk of removal.

3.03 INSTALLATION

A. Set stone in accordance with drawings and shop drawings.

B. Surface Tolerances
   1. Provide 3/8" thick vertical and horizontal joints with a plus or minus allowable tolerance of 3/32".
   2. Set all limestone flush with adjacent units, plumb and in line with finish lines
3. The exposed face of each piece of stone and the faces and edges of adjacent stones shall not deviate either way from a theoretical plane in excess of 1/16" plus or minus for all smooth finish and 1/8" plus when using a 4' long straight edge, when applied in any direction.

C. Joints

1. General
   a. Butter vertical joints full width before setting and set units in full bed of mortar.
   b. Provide setting buttons as required to prevent extrusion of mortar.

2. Wall Caps: Rake out joints to minimum 1" depth. Seal joints with non-staining sealant.

3. Wall Panels
   b. Control Joints: Rake out joints 1-1/2" depth. Point joints with non-staining sealant in accordance with Section 07 92 00.

4. Water Table Bands and Window Sills Mortar Joints: When partially set, compress and compact exposed mortar joints with rounded tool.

5. Joints Between Limestone and Brick Masonry: Rake out joints 3/4" depth. Seal joints with non-staining sealant in accordance with Section 07 92 00. This requirement takes precedence over joint conditions indicated on drawings.

3.04 REPAIR

A. Remove and replace stone units which are broken, stained or otherwise damaged. Provide new matching units, installed as specified and point joints to eliminate evidence of replacement. Report any defective and unsatisfactory joints. Patch or replace stone as required to provide a neat, uniform joint appearance.

3.05 CLEANING AND PROTECTION

A. Cleaning: Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris

B. Protection: Protect installed product’s finish surfaces from damage during construction. Protect stone facing from damage from harmful contaminants.

END OF SECTION
PART 1  GENERAL

1.01 WORK INCLUDED

A. Design and fabricate cast stone elements as indicated on the drawings. Work includes, but is not necessarily limited to the following:
   1. Wall caps.
   2. Wall panels.
   3. Water table bands and window sills.
   4. Column wraps.
   5. Other shapes as indicated.
   6. Non-staining setting mortar and joint sealant.
   7. Accessories to complete the work.
   8. Connection details.

1.02 RELATED SECTIONS

A. Cast-in-Place Concrete: Section 03 30 00.

B. Architectural Precast Concrete: Section 03 45 00.

C. Mortar: Section 04 00 00.

D. Sealant: Section 07 92 00.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals
   1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Submit for all items; include the following as applicable:
   1. Details and sizes of stones.
   2. Arrangement of joints.
   3. Connection details.
   5. Inserts.
   7. Reinforcing.
   8. Method of installation and anchoring.
D. **Samples:** Submit samples representative of finished stone pieces showing full range of color and texture. Resubmit until acceptance by the Architect. Approved samples will be used in the field as a basis of quality for cast stonework submitted on the project.

E. **Design Calculations:** Submit calculations for each type, shape, loading condition and span of cast stone units indicated on the drawings, and all related supports and connections. Design of cast stone shapes and connections shall be under the direct supervision of a Professional Engineer, registered in the State of [Ohio], and calculations shall bear engineer's seal and signature.

F. **Qualification Data:** For manufacturer.

[G. **Existing Stone Shapes:** Where new shapes are being reproduced to match existing profiles and shapes, existing items can be removed and used to fabricate cast stone molds. Remove items by hand and take cautionary methods so as not to damage item being removed and adjacent materials. ]

1.04 **QUALITY ASSURANCE**

A. **Acceptable Manufacturers:** Minimum of five (5) years continuous production experience in cast stone work of quality and scope required on this project, and is a plant certified by the Cast Stone Institute.

B. **Installer Qualifications:** Experienced mason regularly engaged for at least five (5) years in installation of cast stone elements similar to those required on this project.

C. **Comply with ASTM C1364.**

1.05 **JOB MOCK-UP**

A. **General**

1. After standard samples are accepted for color and texture, submit full scale pieces meeting design requirements.

2. A mock-up panel for the exterior masonry is to be built on the site, as specified in Section 04 00 00.

   a. **Water Table Bands and Wall Caps:** Submit full size samples of shapes that will be utilized in the finished work. Samples of water table band and wall cap will be used in constructing the sample panel specified in Section 04 00 00.

3. Mock-up to be standard quality for cast stone work when accepted by the Architect.

1.06 **PRODUCT DELIVERY, STORAGE AND HANDLING**

A. **Delivery and Handling**

1. Transport and handle cast stone with equipment to protect units from dirt and damage.

2. Do not place on ground.

3. Place nonstaining resilient spacers of even thickness between each element.

4. Support cast stone during shipment on expanded polystyrene or similar.
nonstaining shock-absorbing material.

B. Storage
1. Store to protect from contact with soil and from other damage.
2. Store in same position as transported with nonstaining resilient supports located in same position as when transported.
3. Store on firm, level and smooth surfaces.
4. Place stored cast stone so that identification marks are discernible.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement: White Portland Cement, ASTM C150, Type I or III containing not more than 0.60 percent total alkali when tested according to ASTM C114.
1. Use same brand, type and source of supply throughout.

B. Fine Aggregate: Graded and washed manufactured limestone sand meeting ASTM C33; gradation and colors as needed to produce required cast stone textures and colors.
1. Use same type and source of supply throughout.

C. Course Aggregate: Graded and washed crushed limestone meeting ASTM C33; gradation and colors as needed to produce required cast stone textures and colors.
1. Use same type and source of supply throughout.

D. Color: Inorganic, natural or inorganic iron oxide pigments meeting ASTM C979 excluding the use of a cement grade of carbon black pigment.
1. Pigment manufacturer must certify that pigment is lime-proof.
2. Amount: Not to exceed 10% by weight of cement.
3. Manufacturer: SGS Colors by SOLOMON GRIND CHEM SERVICE; DAVIS COLORS or equal.
   [a. Match existing stone. Color match will be determined after cleaning the existing stone.]

E. Admixtures: Use only admixtures specified or approved in writing by Architect.
1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
3. Water Repellent Admixture: MASTERBUILDERS Rheomix 235, EUCLID CHEMICAL, SONNEBORN. Cast stone fabricator must submit certification that proposed water repellent admixture has been used in cast stone work similar to that used on this project.
4. Air-Entraining Admixture: ASTM C260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.

5. Water-Reducing Admixture: ASTM C494, Type A.

F. Water: Potable.

G. Mortar: Type N; see Section 04 00 00.

H. Anchors (Embedded in Cast Stone): Stainless steel, AISI Type 302/304 of type and size determined by fabricator to provide permanent anchorage. Minimum capacity 3 kips.

I. Reinforcing
1. Bars: ASTM A615, Grade 40 or Grade 60, when required, as determined by manufacturer, for safe handling, setting and structural stress. Provide galvanized or epoxy coated.
2. Wire: ASTM A82 Cold-drawn steel wire, ASTM A185 or ASTM A497 welded wire fabric reinforcement, or ASTM A184 steel bar or rod mat reinforcement may be used.
3. Cast Stone Panels: Reinforce as required for handling and to allow for temperature changes and structural stress. Provide a minimum steel reinforcement of 1/4% of the sectional area of the panel; place temperature in both directions when panel is greater than 12" in any direction.

2.02 MIXES

A. Manufacturer: Responsible for mix design as required to achieve strength and surface finish desired.

B. Compressive Strength - 28 Day: Minimum of 6500 psi per ASTM C1194.
1. Tests: Perform in accordance with ASTM C31, ASTM C39 and ASTM C642, except that 2" cube specimens shall be used, oven dried in accordance with ASTM C97.
2. Results: Determined by averaging three specimens per test.
3. Divide compression test results by a factor of 0.8 when saw-cut or core drilled specimens are used.

C. Water Absorption - Average: Maximum 6% dry weight per ASTM C1195.

D. Air Content - ASTM C173 or C 231, for wet cast product shall be 4-8% for units exposed to freeze-thaw environments. Air entrainment is not required for VDT products.

E. Freeze-thaw - ASTM C666 as modified by ASTM C1364: The CPWL shall be less than 5% after 300 cycles of freezing and thawing.

F. Linear Shrinkage - ASTM C 426: Shrinkage shall not exceed 0.065%.

2.03 COLOR AND FINISH
A. Color and Texture: Submit cast stone samples for final selection of color and texture.

Which?
2. Finish: As achieved by acid etch method. Natural limestone appearance.]
2. Finish: Match existing stone as approved by Architect.]

2.04 CAST STONE UNITS

A. Regional Materials: Cast stone units shall be manufactured within 500 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Provide cast stone units complying with ASTM C1364 using either the vibrant dry tamp or wet-cast method.
   1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666, Procedure A, as modified by ASTM C1364.

C. Fabricate units with sharp arrise and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
   1. Provide suitable washes on all exterior copings, projecting courses and pieces with exposed top surfaces.
   2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
   3. Provide drips on projecting elements unless otherwise indicated.

D. Fabrication Tolerances:
   1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
   2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
   3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
   4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

E. Cure units as follows:
   1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
   2. Keep units damp and continue curing to comply with one of the following:
      a. No fewer than five days at mean daily temperature of 70 deg F or above.
      b. No fewer than six days at mean daily temperature of 60 deg F or above.
      c. No fewer than seven days at mean daily temperature of 50 deg F or above.
d. No fewer than eight days at mean daily temperature of 45 deg F or above.

F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

**PART 3 EXECUTION**

3.01 EXAMINATION

A. Examine surfaces to receive cast stone and do not proceed until defects detrimental to the finished work are corrected, including the moisture protection, structural supports, provisions for expansion, or any other conditions which might affect the finished work in appearance, watertightness or integrity of the complete installation.

B. Verify all measurements and dimensions; coordinate the installation of inserts for this work; and coordinate and schedule this work with the work of other trades.

C. Review shop drawings of items or assemblies related to the support or anchorage of cast stone work, including requirements for clearances for proper installation.

3.02 INSTALLATION

A. Do not use cast stone with chips, cracks, voids, stains or other defects which would be visible in the finished work. The setting of any damaged or defective stone is at Contractor's risk of removal.

B. Set cast stone work accurately, straight, level, plumb and square in accordance with Shop Drawings.

C. Unless otherwise indicated, set stone in full mortar bed with vertical joints flushed full. Anchors and dowels shall be firmly placed and all anchor holes and dowel holes and similar holes filled completely with mortar.

1. Copings, projecting belt courses, and in general, all stone areas either partially or totally horizontal: Set with unfilled vertical joints. After setting, insert back-up material or backer rod, prime stone ends and seal, all in accordance with Section 07 92 00.

2. Joints Between Cast Stone and Masonry: Rake joints ¾" deep and seal with non-staining joint sealant in accordance with Section 07 92 00. This requirement takes precedence over joint conditions indicated on drawings.

D. Thoroughly wet stones prior to setting.

E. At sealed or pointed joints, rake joints to a depth of 3/4". Sponge off face of stones to remove excess mortar.

3.03 TOLERANCES
A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.04 PATCHING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect. Repair of cast stone shall be done only by mechanics skilled in this type of repair work, with materials furnished by manufacturer and under manufacturer's direction.

B. Before pointing, clean face of cast stone with a fiber brush, soap powder and water, and thoroughly rinse with clean running water.
   1. Remove excess mortar from face of stone.
   2. No acids or prepared cleaners are permitted without the approval of cast stone manufacturer and Architect.

3.05 POINTING AND SEALING

A. Dampen joints prior to pointing.

B. Point stone joints to a concave surface with pointing mortar. See Section 04 00 00 for mortar.
   1. Pointing in freezing weather or in locations exposed to hot sun, unless properly protected, is not permitted.

C. Seal head joints, where left open for sealing, with sealant in accordance with Section 07 92 00.

3.06 INSPECTION AND ACCEPTANCE

A. Cast stone shall show no obvious repairs or imperfections other than normal color variations when viewed with the unaided eye at a 20 foot distance in good typical daylight illumination.

B. Applicable Standards for Inspection and Quality Control: ACI Committee 311 Manual of Concrete Inspection and PCI MNL-117 Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
B. Protect cast stone at all times from drippings, welding spatter and damage by other trades during construction. Where necessary or directed, substantial non-staining wooden or other approved covering shall be placed to protect the work. Heavy polyethylene film or similar type material shall be used between cast stone and wood. Maintain all protection until removed to permit final cleaning of cast stone work.

1. Protect cast stone during brick cleaning operations, unless cleaning solution has been approved for cast stone and tested in the field on actual cast stone samples.

END OF SECTION
SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Structural steel framing members, as shown on drawings.

B. Grouting under base plates.

1.02  RELATED REQUIREMENTS

A. Section 05 21 00 - Steel Joist Framing.

B. Section 05 31 00 - Steel Decking.

1.03  REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.

B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.

C. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts.


G. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.


J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

K. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless
Carbon Steel Structural Tubing.

N. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
Q. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.
V. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society.
W. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
E. LEED Data: Use Materials and Resources Form to report materials' recycled content, local/regional content, and cost for MR Credits 4 & 5 per Section 01 81 13.
1.05 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."

B. QUALIFICATIONS
   1. Qualifications of Fabricator: Approved by the American Institute of Steel Construction Quality Certification Program, Category STD.
   2. A Fabricator not complying with Category STD shall have fabrication procedures and fabricated steel tested and inspected by an independent testing agency as directed by the Structural Engineer. Tests and inspections are to be performed by AWS Certified Welding Inspectors. Submit copies of the inspection reports to the Structural Engineer. Payment of these tests and inspections will be by the fabricator. Tests and inspection shall include the following:
      a. Examine mill test reports and verify that material being used is the same as the mill test reports.
      b. Review the fabricator’s written welding procedures. Verify that the fabricator’s welding procedures are being adhered to.
      c. Verify that welders are certified with current papers and that they demonstrate proper techniques.
      d. Examine joint preparation for complete penetration joints. Ultrasonically test complete penetration joints.
      e. Examine fillet welds for proper size, profile, throat, porosity, and end returns.
      f. Examine steel members for laminations. Spot check dimensions and hole sizes.
      g. The purpose of this inspection is to enable the testing agency to verify that, in general, the steel is being fabricated in accordance with the project specifications. A minimum of one trip per week is recommended. The first trip should be scheduled in the early stages of fabrication.

C. Fabricator: Company specializing in performing the work of this section with minimum five years of documented experience.

D. Erector: Company specializing in performing the work of this section with minimum five years of documented experience.

E. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Tennessee.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Angles and Plates: ASTM A36/A36M.

B. Rolled Steel Structural Shapes: ASTM A992/A992M.
C. Cold-Formed Structural Tubing: ASTM A500, Grade B.

D. Hot-Formed Structural Tubing: ASTM A501, seamless or welded.


F. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A galvanized to ASTM A153/A153M, Class C.

G. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, medium carbon, galvanized.

H. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or A563M nuts and ASTM F436 Type 1 washers.


J. Welding Materials: AWS D1.1; type required for materials being welded.

K. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C1107M and capable of developing a minimum compressive strength of 7,000 psi at 28 days.

L. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

C. Fabricate connections for bolt, nut, and washer connectors.

D. Develop required camber for members.

2.03 FINISH

A. Prepare structural component surfaces in accordance with SSPC SP 1.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

2.04 SOURCE QUALITY CONTROL

A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing at least 10 percent of bolts at each connection.

B. Welded Connections: Visually inspect all shop-welded connections and test at
least 10 percent of welds using one of the following:
1. Radiographic testing performed in accordance with ASTM E94.
2. Ultrasonic testing performed in accordance with ASTM E164.
3. Liquid penetrant inspection performed in accordance with ASTM E165.
4. Magnetic particle inspection performed in accordance with ASTM E709.

C. 100% of Complete and Partial Penetration Groove Welds shall be ultrasonically tested.

**PART 3  EXECUTION**

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".

B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".

E. Do not field cut or alter structural members without approval of Architect.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset from True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00.
B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing at least 10 percent of bolts at each connection.

C. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E94.
   2. Ultrasonic testing performed in accordance with ASTM E164.
   3. Liquid penetrant inspection performed in accordance with ASTM E165.
   4. Magnetic particle inspection performed in accordance with ASTM E709.

D. 100% of Complete and Partial Penetration Groove Welds shall be ultrasonically tested.

END OF SECTION
SECTION 05 21 00
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   1. Steel Joist notes on Construction Document drawing 2-S002

1.02 SUMMARY

A. Section Includes:
   A. K-series steel joists.
   B. LH- and DLH-series long-span steel joists.
   C. Joist girders.
   D. Joist accessories.

B. Related Requirements:
   1. Section 03 30 00 "Cast-in-Place Concrete" for installing bearing plates in concrete.
   2. Section 04 20 00 "Unit Masonry" for installing bearing plates in unit masonry.
   3. Section 05 12 00 "Structural Steel Framing" for field-welded shear connectors.

1.03 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.04 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. LEED Submittals:
   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
   2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products 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.

C. Shop Drawings:
1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Welding certificates.

C. Manufacturer certificates: Signed by manufacturers certifying that joists comply with requirements.

D. Mill Certificates: For each type of bolt. Signed by bolt manufacturers certifying that bolts comply with requirements.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications.
1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.08 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.
PART 2  PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
   1. Use ASD; data are given at service-load level.
   2. Design special joists to withstand design loads with live-load deflections no greater than the following:
      a. Floor Joists: Vertical deflection of 1/360 of the span.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 30 percent.

2.02 K-SERIES STEEL JOISTS


B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top chord extensions where indicated, complying with SJI's "Specifications."

E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

F. Do not camber joists.

G. Camber joists according to SJI's "Specifications." Or as indicated.

H. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.03 PRIMERS

A. 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."

B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
2.04 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated.

C. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

E. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers.
   1. Finish: Plain.

F. Welding Electrodes: Comply with AWS standards.

G. Galvanizing Repair Paint: ASTM A780.

H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.05 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

C. Before installation, splice joists delivered to Project site in more than one piece.

D. Space, adjust, and align joists accurately in location before permanently fastening.

E. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

F. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

G. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.


I. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Visually inspect field welds according to AWS D1.1/D1.1M.
1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709.

C. Visually inspect bolted connections.

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.04 PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
   1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
   2. Apply a compatible primer of same type as primer used on adjacent surfaces.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, which ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION
**SECTION 05 31 00**

**STEEL DECKING**

**PART 1  GENERAL**

1.01 SECTION INCLUDES

A. Roof deck.
B. Composite floor deck.
C. Metal form deck.
D. Supplementary framing for openings up to and including 18 inches.
E. Bearing plates and angles.
F. Stud shear connectors.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Reinforcing and concrete topping over metal deck.
B. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
C. Section 05 21 00 - Steel Joist Framing: Support framing for openings larger than 18 inches.
D. Section 05 50 00 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.03 REFERENCE STANDARDS

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
D. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society.
E. AWS D1.3 - Structural Welding Code - Sheet Steel; American Welding Society.
F. SDI (DM) - Publication No.31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute.
G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic");
The Society for Protective Coatings.

H. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.

B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Tennessee.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.

1. Calculate to structural limit stress design and structural properties specified.


5. Maximum Lateral Deflection of Diaphragms: 1/500 of the height of the wall.
B. Roof Deck: Non-composite type, fluted steel sheet:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS), with G90/Z275 galvanized coating.
   a. Grade as required to meet performance criteria.
2. Structural Properties as shown on Structural Drawings.
   a. Span Design: Multiple.
3. Profile: Fluted; SDI NR.
4. Formed Sheet Width: 24 inch.
5. Side Joints: Lock seam.

C. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
2. Structural Properties as shown on Structural Drawings.
4. Profile: Fluted; SDI NR.
5. Formed Sheet Width: 24 inch.
7. End Joints: Lapped, welded.

D. Metal Form Deck: Corrugated sheet steel, with provision for ventilation of concrete:
3. Nominal Height: 2 inch.
4. Formed Sheet Width: 24 inch.
5. Side Joints: Lapped, welded.

2.02 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.

B. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.


D. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

E. Shop and Touch-Up Primer: SSPC-Paint 25, zinc oxide, complying with VOC limitations of authorities having jurisdiction.

F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

G. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.
2.03 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage thick sheet steel; of profile and size as indicated; finished same as deck.

B. Cant Strips: Formed sheet steel, 22 gage thick, 45 degree slope, 3 1/2 inch nominal width and height, flange for attachment.

C. Roof Sump Pans: 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

D. Floor Drain Pans: 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 1-1/2 inch bearing.

D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
   1. Welding: Use fusion welds through weld washers.
   2. Place and secure special deep fluted sections for integral concrete bridging.

E. Clinch lock seam side laps.

F. At mechanically fastened male/female side laps fasten at 24 inches on center maximum.

G. At welded male/female side laps weld at 18 inches on center maximum.

H. Weld deck in accordance with AWS D1.3.

I. At deck openings from 6 inches to 18 inches in size, provide 2 x 2 x 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

J. At deck openings greater than 18 inches in size, provide 3 x 3 x 3/8 inch steel angle
angle reinforcement. Place angles perpendicular to flutes attached to the floor/roof beams/joists and fusion weld to deck at each flute.

K. Where deck changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

L. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.

M. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

N. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

O. Place metal cant strips in position and fusion weld.

P. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

Q. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

R. Weld stud shear connectors through steel deck to structural members below.

S. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION
SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Shop fabricated steel and aluminum items.

1.02 RELATED REQUIREMENTS
A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.
C. Section 05 51 00 - Metal Stairs.
D. Section 05 52 13 - Pipe and Tube Railings.
E. Section 09 90 00 - Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS
J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.


U. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society.

V. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society.

W. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; American Welding Society.

X. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings.


Z. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing,
anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Design all items under direct supervision of a Professional Engineer experienced in design of this Work and licensed in Tennessee.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.
B. Steel Tubing: ASTM A500, Grade B cold-formed structural tubing.
C. Plates: ASTM A283.
E. Slotted Channel Framing: ASTM A653, Grade 33.
F. Slotted Channel Fittings: ASTM A1011/A1011M.
G. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
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.

2.02 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.
G. Bolts, Nuts, and Washers: Stainless steel.
H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 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. Continuously seal joined members by continuous welds.
D. 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.
E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
   1. Side Rails: 3/8 x 2 inches members spaced at 20 inches.
   2. Rungs: one inch diameter solid round bar spaced 12 inches on center.
   3. Space rungs 7 inches from wall surface.
B. Bumper Posts and Guard Rails: As detailed; prime paint finish.
C. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
D. Joist Hangers: Strap anchors, fabricated with 16 gage steel; galvanized finish.
E. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
F. Lintels: As detailed; prime paint finish.
G. Sill Angles for Tempered Glass Railing Assemblies: ASTM A36/A36M steel angles with anchoring devices and sizes as indicated in shop drawings for railing assembly, drilled and tapped for fastener types, sizes, and spacing indicated,
prime paint finish.

H. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.

I. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.

J. Toilet Partition Suspension Members: Steel channel sections; prime paint finish.

K. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

2.05 FINISHES - STEEL

A. Prime paint all steel items.
   1. Exceptions: Galvanize items to be embedded in concrete or masonry.
   2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.06 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Class I natural 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.

2.07 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.
D. Maximum Bow: 1/8 inch in 48 inches.
E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION
A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION
A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components indicated.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 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
SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide miscellaneous metals as indicated on the drawings and specified herein. Work includes, but is not limited to:
   1. **Ladders**.
   2. Stairs; work includes design.
   3. Loose steel lintels.
   4. Steel railings and handrails; work includes design.
   5. **Downspout boot castings**.
   6. Loose leveling and bearing plates.
   7. Stair nosing.
   8. Miscellaneous steel framing and supports which are not indicated as part of structural steel work.
   9. Miscellaneous steel members to be embedded in concrete.
   10. Concrete filled steel pipe protection posts (pipe bollards).
   11. Structural channel frames.
   12. Curb and floor opening angles.
   13. Elevator sill angles and elevator intermediate structural supports.
   14. Lavatory counter supports.
   15. Supports above ceilings for ceiling hung items (folding partition, toilet partition, etc).
   16. **Floor grating**.

1.02 RELATED SECTIONS

A. **Sustainable Design Requirements**: Section 01 81 13.

B. **Structural Steel**: Section 05 12 00.

C. **Cold-Formed Metal Framing**: Section 05 40 00.

D. **Painting**: Section 09 90 00.

E. **Decorative Metals**: Section 05 70 00.

1.03 REFERENCES

A. **Steel Construction Manual**: American Institute of Steel Construction (AISC).

B. **American Welding Society (AWS)**.
   1. AWS D1.1 - Structural Welding Code - Steel.
   2. AWS D1.3 – Structural Welding Code – Sheet Steel.
   3. AWS D1.2 – Structural Welding Code – Aluminum.
   4. AWS D1.6 – Structural Welding Code – Stainless Steel
C. American Society for Testing and Materials (ASTM).
   1. ASTM A36 - Structural Steel.
   2. ASTM A53 - Pipe, Steel, Black, Hot-Dipped, Zinc-coated Welded and Seamless.
   3. ASTM A123-Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   4. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A283 – Low and Intermediate Tensile Strength Carbon Steel Plates.
   6. ASTM A307 - Carbon Steel Bolts and Studs Externally and Internally Threaded Fasteners, 60,000 PSI Tensile Strength.
   8. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   9. ASTM A501–Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
   11. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   12. ASTM A569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
   13. ASTM A570 - Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
   14. ASTM A611 - Steel Sheet, Carbon, Cold-Rolled, Structural Quality.
   15. ASTM A780- Practice for Repair of Damaged Hot-Dip Galvanized Coatings.
   16. ASTM A786 - Rolled Steel Floor Plates.
   18. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.
   20. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate.
   23. ASTM B632 – Aluminum-Alloy Rolled Tread Plate.

D. American National Standards Institute (ANSI)
   1. ANSI A14.3 - Safety Requirements for Fixed Ladders
   2. ANSI Z49.1 – Safety in Welding, Cutting and Allied Processes

E. National Association of Architectural Metal Manufacturers, (NAAMM).

F. Society for Protective Coatings (SSPC)
   1. SSPC-SP1 - Solvent Cleaning
   2. SSPC-SP2 - Hand Tool Cleaning
   3. SSPC-SP3 - Power Tool Cleaning
   4. SSPC-SP6 - Commercial Blast Cleaning
   5. SSPC-SP11 - Power Tool Cleaning to Bare Metal

G. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."
1.04  PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs and railings and ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.05  SUBMITTALS

A. Shop Drawings - General: Submit for all items.

B. Shop Drawings – Stairs and Handrails: Indicate in detail construction, gages of metals,jointing, methods of installation, fastening and supports, location and sizes of welds, anchors, hangers and other pertinent information and data.
   1. In addition, submit plans and details of stairs and handrails, drawn to scale not less than 1/4 inch per foot.
   2. Shop drawings shall contain design, type of steel and load assumption, bearing the seal of a licensed professional engineer registered in the State of Tennessee.

C. Samples: Submit samples of materials or workmanship, if requested by the A/E.

D. Stair manufacturer’s certificate of compliance with the Architectural Products Division of the National Association of Architectural Metal Manufacturer's AMP 510 Metal Stairs Manual materials, construction and installation specification.


1.06  QUALITY ASSURANCE

A. Fabricate and install metal items in accordance with applicable standards of AISC and NAAMM. Welding and related procedures in accordance with AWS.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1 - Structural Welding Code - Steel.
   2. AWS D1.2 - Structural Welding Code - Aluminum.

C. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

D. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set
in concrete or built into masonry for installation of miscellaneous metal work. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

1.07 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

1.08 COORDINATION

A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of miscellaneous metal work. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

1.09 STORAGE AND HANDLING

A. Protect from corrosion.

B. Store materials in a weathertight and dry place until ready for use in the work.

C. Store packaged materials in their original unbroken package or container.

PART 2 PRODUCTS

2.01 MATERIALS

A. Ferrous Metals

1. Steel Shapes, Bars and Plates: ASTM A36.
2. Steel Plates to be Bent or Cold Formed: ASTM A283, Grade C.
   a. Pipe Bollards: Heavy weight, schedule 80.
4. Steel for Gratings: ASTM A569 or A36.
5. Steel Tubing: ASTM A500, Grade A, cold-formed; or ASTM A501, hot-formed.
6. Steel Sheets: Hot-rolled ASTM A570, Class 1, Grade 36; or cold-rolled ASTM A611, Grade C, Type 1.
7. Galvanized Steel Sheets: ASTM A653 Grade 33, G90 coating.

B. Aluminum

4. Aluminum Extrusions: ASTM B221, Alloy 6063-T6

C. Stainless Steel
1. Bar Stock: ASTM A276, Type 302 or 304.
2. Plate: ASTM A167, Type 302B.

D. Gray Iron Castings: ASTM A48, minimum Class 30B.

E. Floor Plate
   1. Steel: ASTM A786, Pattern No. 1, 2, 3, 4, or 5; hot-dip galvanized ASTM A123, Thickness Grade 85.
   2. Steel; ASTM A786, hot-dip galvanized ASTM A123, Thickness Grade 85.
      a. Finish: Aluminum oxide granules set in epoxy adhesive to provide non-slip surface. Similar to Mebac by McNICHOLS COMPANY.

F. End Welded Studs
   1. Material: Compatible with material to which it is attached.
   2. Type: Automatically end welded in the shop or field, head or bent top.
   4. Size: Diameter and length as indicated.

G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded

2.02 FASTENERS

A. General
   1. Provide fasteners of types as required for assembly and installation of fabricated items.
   2. Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941; Class Fe/Zn 5; at exterior walls.

B. Bolts, Nuts and Washers: Regular hexagon head type, externally and internally threaded fasteners; include necessary nuts and plain hardened washers. Provide the following materials/finishes:
   1. Steel: ASTM A307 Grade A bolts; A563 nuts. For members for support of structural members or connection thereto, provide ASTM A325 bolts.
   2. Stainless Steel: ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1

C. Expansion Anchors: Stainless steel "DH Bolts" or "Ankr Tite" devices by WEJ-IT or similar by REDHEAD, HILTI or SIMPSON. Length as required to provide minimum 2-1/2" embedment into sound masonry.

D. Adhesive Type Anchor Bolts – In Hollow CMU: Chemically grouted adhesive anchor systems with nylon or stainless steel screen inserts. Use 1/2 inch diameter anchors, unless otherwise noted.
   1. HIT HY-70 Adhesive Anchors, HILT, INC.
   2. EPCON System, ITW/RAMSET/RED HEAD
   3. Chem-Stud Adhesive Anchors, RAWLPLUG COMPANY, INC.
4. Simpson Set Epoxy-Tie Adhesive Anchors, SIMPSON STRONG-TIE COMPANY, INC.

E. Adhesive Type Anchor Bolts - In solid grouted CMU and Concrete: Chemically grouted adhesive anchor systems. Use ¾ inch diameter anchors, unless otherwise noted.
   1. HIT HY 200 or RE-500 V “Safe Set System” Adhesive Anchors, HILTI, INC.
   2. EPCON System, ITW/RAMSET/REDHEAD
   3. Chem-Stud Adhesive Anchors, POWERS FASTENERS, INC.
   4. Simpson Set Epoxy-Tie Adhesive Anchors, SIMPSON STRONG-TIE COMPANY, INC.

F. Miscellaneous Fasteners
   1. Lag Bolts: ANSI B18.2.1.
   4. Plain Washers: Round, carbon steel, ANSI B18.22.1
   5. Toggle Bolts: Tumble-wing or spring wing type, FS FF-B-588, type, class, and style as required.

2.03 MANUFACTURED ITEMS

A. Downspout Boot Casting
   1. Material: Gray cast iron.
   2. Type: NEENAH Series R-4929-03, offset shape; JORDAN IRON WORKS; FLOCKHART, or equal.
   3. Size: Accepts 3” x 4” downspout.
   4. Length: As indicated on drawings. If not indicated, provide 32” high boots.

B. Concrete Stair Nosings
   1. Use: Concrete panfilled treads and cast-in-place concrete stairs.
   2. Type: Extruded aluminum with aluminum oxide/silicone carbide abrasion anti-slip filler strips and integral anchor.
   3. Size: 3” wide by 1/4” thick by full length of tread for panfilled and 6” less than width of tread for cast-in-place (3” each end).
   5. Manufacturer: WOOSTER PRODUCTS, Type 231BF for panfilled, Type 231 for cast-in-place; AMERICAN ABRASIVE METALS COMPANY; BALCO.

C. Photoluminescent Concrete Stair Nosings
   1. Use: Concrete panfilled treads stairs.
   2. Type: Extruded aluminum with 1” wide photoluminescent insert and 3 aluminum oxide/silicone carbide abrasion anti-slip filler strips and integral anchor.
   3. Size: 3” wide by 1/4” thick by full length of tread.
   4. Photoluminescent Strip: Phosphorescent pigment, Strontium Aluminate Oxide, combined with a carrier/fixer that is cross-linked to an aluminum
substrate at high temperature. PVC based systems shall not be acceptable.

a. Brightness Rating shall exceed New York City Reference Standard RS 6-1 and 6-1A of BR: 30-7-5 when tested in accordance with ISO 17398.

b. 2. UL 1994: Pass

c. ASTM E 2072, as modified by IBC Section 1024

d. UV Degradation: 2000 hours when tested in accordance with ASTM G155.


g. Rate of Burning: ASTM D635, comply.

h. Toxicity Testing: Bombardier SMP800-C “Toxic Gas Generation Test”.

i. Radioactivity Test: ASTM D3648.


5. Manufacturer: BALCO Model No. P-3310-PL-100 equal by WOOSTER PRODUCTS, or AMERICAN ABRASIVE METALS COMPANY.

D. Aluminum Gratings and Frames

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ALABAMA METAL INDUSTRIES CORPORATION; A GIBRALTAR INDUSTRIES COMPANY.

   b. IKG INDUSTRIES; A DIVISION OF HARSOCO CORPORATION.

   c. OHIO GRATINGS, INC.

   Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.

   a. Bearing Bar Spacing: 15/16 inch o.c.

   b. Bearing Bar Depth: Minimum 1-1/2 inches; as required to comply with structural performance requirements.

   c. Bearing Bar Thickness: 3/16 inch.

   d. Crossbar Spacing: 2 inches o.c.

   e. Traffic Surface: Plain.


3. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

   a. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two bearing bars.

   b. Furnish self-drilling fasteners with washers for securing grating to supports.

4. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

   a. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
5. Do not notch bearing bars at supports to maintain elevation.

6. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
   a. Unless otherwise indicated, fabricate from same basic metal as gratings.
   b. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

7. Loading: Grating to carry a pedestrian loading equal to a uniform load of 125 lbs. per square foot over the required clear span with deflection not to exceed 1/4".

E. Steel Gratings and Frames  yes / no ?

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ALABAMA METAL INDUSTRIES CORPORATION; A GIBRALTAR INDUSTRIES COMPANY.
   b. IKG INDUSTRIES; A DIVISION OF HARSCO CORPORATION.
   c. OHIO GRATINGS, INC.

2. Welded Steel Grating: MBG W-15-4:
   a. Bearing Bar Spacing: 15/16 inch o.c.
   b. Bearing Bar Depth: Minimum 1-1/2 inches; as required to comply with structural performance requirements.
   c. Bearing Bar Thickness: 3/16 inch.
   d. Crossbar Spacing: 4 inches o.c.
   e. Traffic Surface: [Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive].
   f. Steel Finish: [Shop primed] [Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface].

3. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
   a. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two bearing bars.
   b. Furnish self-drilling fasteners with washers for securing grating to supports.

4. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
   a. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

5. Do not notch bearing bars at supports to maintain elevation.
6. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
   a. Unless otherwise indicated, fabricate from same basic metal as gratings.
   b. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by ¼” thick by 8” long.

7. Loading: Grating to carry a pedestrian loading equal to a uniform load of 125 lbs. per square foot over the required clear span with deflection not to exceed 1/4”.

E. Gratings (Landings and Treads)
   1. Material: Steel
   2. Manufacturers: IKG BORDEN Type WB (serrated surface), OHIO GRATING, BLAW-KNOX EQUIPMENT, DRAVO CORPORATION or equal.
   4. Treads: Prefabricated type with non-skid serrated wearing surface and checkered plate nosing. Hot-dip galvanized after fabrication.
   5. Size of Bearing Bars: Minimum 3/16” thick x 1-1/2” deep as shown on drawings.
   6. Adjacent Sections: Align bars so they appear continuous.
   7. Joints: Do not locate landing joints at top of steps.
   8. Clips: Manufacturer’s standard saddle type. Clip used to secure each section of grating to supporting members.

F. Gratings and Stair Treads
   1. Steel
      a. Type: McNICHOLS COMPANY GCM-2-125A or equal by IKG INDUSTRIES, OHIO GRATING, BLAW-KNOX EQUIPMENT, or DRAVO CORPORATION.
      b. Finish: Hot-dipped galvanized, ASTM A123 with aluminum oxide granules set in epoxy adhesive to provide non-slip surface. Similar to Mebac by McNICHOLS COMPANY.
   2. Adjacent Sections: Align bars so they appear continuous.
   3. Joints: Do not locate joints at top of steps.
   4. Tread Nosing: Solid with same finish as grating surface.

G. Grating Planks
   1. Type: Interlocking planks with serrated non-slip walking surface.
   3. Thickness: 4”.
   4. Manufacturer: UNITED INTERLOCK (UNISTRUT); GRIP STRUT METALS; IKG BORDEN.
   5. Provide hold down clips of type and quantity as recommended by manufacturer for supporting conditions.

H. Castings
1. Material: Cast iron unless otherwise shown on drawings.

2. Type: NEENAH FOUNDRY CO., types and accessories as indicated on drawings, or equal, by FLOCKHART; JORDAN IRON WORKS or equal.

I. Handrail Wire Mesh Inserts: Welded wire fabric; 3/16" diameter wire; 3"x 3" openings. yes / no ?
   1. Provide perimeter of mesh panel framed and connect to railing supports as indicated on drawings.
   2. Manufacturer: G-S COMPANY, McNICHOLS COMPANY, KENTUCKY METAL PRODUCTS.

J. Exterior Gates: Ornamental swing gates consisting of steel framing, infill panels and hardware; supported by masonry piers.
   1. Size: As indicated on drawings.
   2. Components
      a. Framing: Welded frame fabricated from minimum 2" x 2" steel tubing.
      b. Infill: AMETCO Shadow 100 Panel.
      3. Hardware
         a. Hinges: Size and type as determined by manufacturer. Provide 2 hinges for each leaf up to 6 feet high and 1 additional hinge for each additional 24 inches in height or fraction thereof.
         b. Provide padlockable, 5/8 inch diameter center cane bolt assembly and strike.
   4. Finish
      a. Gate panels and framing shall be hot-dip galvanized to 1.25 ounces per square foot minimum zinc coating in accordance with ASTM A123.
   5. Manufacturer: AMETCO, MONUMENTAL IRON WORKS/MASTER HALCO INC.; STEWART IRON WORKS; PAYNE METAL WORKS, INC.

2.04 FABRICATION

A. General
   1. Workmanship
      a. Construct all items to ensure ease of installation and minimal field adjustment.
      b. Use materials of size and thickness shown, or, if not shown, of required size and thickness to produce strength and durability in finished product. Ease exposed edges to a radius of approximately 1/32 inch. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
      c. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces. Grind crotches to 1/8" radius.
      d. Form exposed connections with hairline joints, flush and smooth.
   2. Field Measuring: Field measure all items required to obtain proper fit.
3. Exposed mill names and logos not permitted in finished work.

B. Steel Stairs
1. General: Construct stairs to conform to sizes and arrangements shown: Join pieces together by welding unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, railings, struts, clip brackets, bearing plates and other components for the support of stairs and platforms and as required to anchor and contain the stairs on supporting structure.

2. Design: Comply with all applicable building laws and ordinances. Stairs to be designed to sustain a live load of 100 psf and a concentrated load of 300 lbs. Sizes of members shown on drawings are minimums. Furnish heavier members if necessary to meet design requirements.

3. Stair Framing: Fabricate stringers of structural steel channels. Provide closures for exposed ends of stringers. Construct platforms (landings) of structural steel channel headers and miscellaneous framing members as shown. Bolt or weld headers to stringers and framing members to strings and headers; fabricate and join so bolts, if used, do not appear on finish surfaces.

4. Pan-Filled Stairs
   a. Metal Pan Risers, Subtreads, and Subplatforms (Landings): Shape metal pans for risers and subtreads to conform to configuration shown. Provide thicknesses of structural steel sheet for metal pans indicated but not less than that required to support total design loading. Form metal pans of hot-rolled or cold-rolled carbon steel sheet, unless otherwise indicated.

   b. Attach risers and subtreads to stringers by means of brackets made of steel angles. Weld brackets to strings and weld metal pans to brackets.

   c. Provide subplatforms of configuration and constructions indicated, or if not indicated, of same metal as risers and subtreads and in thicknesses required to support design loading. Attach subplatform to platform framing members with welds.

5. Grating Stairs
   a. General: Install galvanized steel grating treads and landings as indicated.

   b. Treads: Prefabricated.

   c. Landings: Welded steel grating with serrated or non-skid wearing surfaces. Provide checkered plate nosing at stair. Band all edges. Hot-dip galvanized after fabrication

6. Floor Plate Stairs: Install floor plate treads and landings as indicated

C. Ship's Ladder
1. Design and fabricate to support live load of 100 lbs. per sq. ft. Stair, [crossover] and handrail arrangement as indicated.

2. Stringers: Structural steel channels or steel plates.

3. Treads: [Open steel grating] [Floor plate] type.

4. Handrails: Seamless steel pipes meeting requirements specified herein.

5. Finish: [Paint primed for interior installation]. [Hot-dipped galvanized for exterior installation].
D. Ladders
1. Fabricate ladders for the locations shown with dimensions, spacings, details and anchorages as indicated. Comply with the requirements of ANSI A14.3 and OSHA, except as otherwise indicated.
   a. Unless otherwise shown on the drawings, provide 1/2 inch x 2-1/2 inch continuous structural steel flat bar stringers with eased edges, spaced 18 inches apart.
   b. Provide 1 inch diameter solid structural steel bar rungs, spaced maximum 12 inches on center.
2. Center rungs on stringers, plug weld and grind smooth on outer rail faces.
3. Coat top of each rung with aluminum oxide granules set in epoxy adhesive to provide non-slip surface.
5. Provide semi-circular safety cages with flared bottom where ladders height exceeds 20'-0". The back of the cage must extend between 27 and 30 inches from each ladder rung, measured from the center of the rung. Cage shall be connected to the ladder, or to the structure to which the ladder is fixed, by horizontal bands, and there shall be a horizontal band at least every 4 feet. Provide vertical bars, no more than 9.5 inches from each other, connecting the horizontal bands. The vertical bars must also be connected to the inside of the horizontal bands. Locate bottom of cage between 7'-0" and 8'-0".
6. At public access locations and where indicated, provide expanded metal hinged security gate at gage bottom with lockable hasp.

E. Handrail/Guardrail: Fabricate as indicated on the drawings. [Provide mesh inserts as detailed.]
1. Material: Steel pipe or shapes as detailed; meeting the requirements specified herein for the specific material.
2. Loadings: Steel guardrails and handrails shall meet the following load requirements:
   a. Welded construction, fabricated, complete with connectors to structure designed for a concentrated load of 200 pounds applied at any point and in any direction on the handrail and at the top of the guardrail and in compliance with OBC.
   b. Guardrails: Designed and constructed for a load of 50 pounds per lineal foot applied horizontally at the required guardrail height and a simultaneous load of 100 pounds per lineal foot applied vertically downward at the top of the guardrail.
   c. Guardrails: Designed and constructed to resist a 200 pound concentrated horizontal load applied on a one foot square area at any point in the system including intermediate rails or other elements serving this purpose.
   d. Handrails: Designed and constructed for a load of 50 pounds per lineal foot applied in any direction and in compliance with the OBC.
   e. Loading conditions in paragraphs a, b, c and d shall not be applied simultaneously, but each shall be applied to produce maximum stress in each of the respective components or any of the supporting components.
3. Verify dimensions on site prior to shop fabrication.
4. Railing system shall be assembled in a shop in largest sizes for delivery to
site and for installation; to minimize field-splicing and assembly.

a. Rails shall be disassembled only as necessary for shipping and handling.
b. Rails shall be marked for re-assembly and coordinated installations.

5. Close open ends of railings, not scheduled to be closed with finials, with close fitting steel plates welded in place and ground smooth.

6. Welded Connection: Cope intersections of rails and posts, weld joints and grind smooth. Butt weld end-to-end joints of railings, or use welding connections at fabricator's option.

7. Form simple and compound curves by bending pipes in jigs to produce uniform curves.
   a. Maintain profile of pipes throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces.

8. Space posts and wall brackets as indicated. If not indicated, 7'-0" maximum center to center.

9. Brackets, Flanges and Anchors: Provide for railing posts and handrail supports. Provide inserts and sleeves as required for anchorage to concrete or masonry.

10. Provide wall returns at ends of wall mounted rails.

11. For Exterior Installations: Provide weepholes or other means for evacuation of water trapped in pipe rails.

12. Expansion Joints: Provide expansion joints at locations indicated. If not indicated, locate at intervals not to exceed 40 feet.
   a. Provide slip-joint interval sleeve extending beyond joint on each side; secure sleeve to one side.
   b. Do not locate expansion joints closer than 6" from post.

13. Toe Boards: Where indicated, provide toe boards around openings and at edge of open-sided floors and platforms.
   a. Fabricate to dimensions and details shown.

F. Miscellaneous Steel Lintel: Provide sizes and shapes as indicated with 8" minimum bearing each jamb, unless otherwise noted. When lintel is fabricated of two or more members to accommodate thickness of wall, weld adjacent members to form a single unit.

1. Unless otherwise indicated, provide one 3-1/2" wide angle leg for each nominal 4" wythe of masonry.

G. Miscellaneous Embedded Items: Provide steel members of shapes and size required per drawings. Equip members to be anchored into concrete or masonry with welded on anchor straps or weld studs as shown or required. Spacing and location of anchors per drawings, but if not otherwise detailed, provide at ends and at maximum intervals of 12" with minimum two per member.

H. Miscellaneous Framing and Supports
1. Provide as indicated on drawings.
2. Fabricate members and assemblies to size, shape and dimensions detailed with provisions to receive adjacent construction supported by such items.

I. Miscellaneous Loose Steel Items: Provide steel shapes such as channels, angles, plates, protection posts, etc., as indicated on drawings.

J. Accessories: Provide all clips, bolts, anchors, fasteners, etc., as required for
completion of miscellaneous metal work. Type, size and strength as noted or as suitable for conditions and construction involved.

K. Stair Nosings: Provide single length sections; no joints permitted within the width of a stair tread.

L. Counter Supports:
1. Surface Mounted: 1/8” steel with 45 degree notch that allows for wall cleat and wire run clearance.
   a. Load to Deformation: 1500 lbf/pair minimum.
   c. Manufacturer: A&M HARDWARE or approved equal
2. In-Wall Mounted (Concealed): Fabricate from steel angles and welded in sizes indicated or as required.
   a. Load to Deformation: 650 lbf/pair minimum.
3. Accessories: Provide all required fasteners to structure type provided.

2.05 FINISHES

A. Preparation: Grind all exposed cut surfaces as required to remove burrs and sharp edges.

B. Galvanizing
1. Galvanize all ferrous metal items exposed to weather, embedded in masonry or concrete, and where indicated.
2. Hot-dip galvanize after fabrication in accordance with ASTM A123; provide minimum of 2 oz. of galvanizing (Grade 85) per sq. ft. of subsurface. Prepare and pretreat surfaces as recommended by galvanizer. Do not weld after galvanizing.
3. Galvanizing Repair Paint: Minimum 79% zinc dust by weight in dried film. TNEMEC COMPANY, INC., No. 92 Tneme-Zinc; ZRC Cold Galvanizing Compound by ZRC, Zinc-rich Galvax by ALVIN PRODUCTS.
4. Do not use stainless steel or other non-galvanized fasteners in the assembly of galvanized components.

C. Shop Painting (Non-galvanized Ferrous Metal)
1. Cleaning: After fabrication, clean all items of loose scale, rust, oil, dirt or other foreign matter.
4. Paint: One shop coat of paint compatible with the finish paint system. Section 09 91 00.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages, settings drawings, diagrams, templates,
instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.02 INSTALLATION

A. General
1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
2. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and level. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
3. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
4. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work. Comply with the following requirements:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercut or overlap.
   c. Remove welding flux immediately.
   d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
5. Protection from Dissimilar Materials: Coat all aluminum surfaces in contact with steel, concrete or masonry with one coat of heavy bodied bituminous paint. Where aluminum contacts steel surfaces, and only where specifically approved, the painting required on the steel surface may be substituted for the bituminous paint.

B. Handrail
1. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or specified herein. Plumb posts in each direction. Secure posts in each direction. Secure posts and railing ends to building construction as follows.
2. Anchor posts to concrete as indicated on the drawings.
3. Weld posts to channels as indicated.
4. Secure handrails to wall with wall brackets. Provide brackets with not less than 1-1/2” clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required for
design loading. Secure wall brackets and wall return fittings to concrete or masonry with expansion bolts.

C. Stair Nosings: Use on all concrete and concrete pan filled treads.

D. Gratings and Frames

1. Field Cutting: Only with permission of Architect.
2. Bearing Bars at Supports: Notching to maintain elevations not permitted.
3. Rejection: Bent or warped grating in excess of those specified in the Metal Bar Grating Manual will be rejected.
4. Clearance Between Panels
   a. General: Allow approximately 1/8" clearance between adjacent panels (or panel and frame) at 70 degrees F., except that the total accumulated clearance between any number of panels in a single frame shall fall within the following ranges:

<table>
<thead>
<tr>
<th>FRAME DIMENSION (feet)</th>
<th>ACCUMULATED CLEARANCE (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 - 10</td>
<td>Minimum 1/8  Maximum 3/8</td>
</tr>
<tr>
<td>10 - 30</td>
<td>Minimum 3/16  Maximum 3/4</td>
</tr>
<tr>
<td>30 - 50</td>
<td>Minimum 3/8  Maximum 1-1/4</td>
</tr>
<tr>
<td>50 - 80</td>
<td>Minimum 1/2  Maximum 2</td>
</tr>
</tbody>
</table>
   b. Spacers: Spacers welded to the edge of the intermediate panels may be used to reduce excessive clearance.
5. Clips: Provide two at each end support and one at each intermediate support.

3.03 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION
SECTION 05 5 100
METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairs with concrete treads.
B. Stairs with metal treads.
C. Stairs with grating treads.
D. Structural steel stair framing and supports.
E. Handrails and guards.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete fill in stair pans and landings; mesh reinforcement for landings.
B. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal anchors in concrete.
C. Section 05 50 00 - Metal Fabrications.

1.03 REFERENCE STANDARDS

H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
J. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-
Strength Low-Alloy, and Alloy Steel Floor Plates.

K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society.

L. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society.

M. NAAMM AMP 510 - Metal Stairs Manual; The National Association of Architectural Metal Manufacturers.

N. NAAMM MBG 531 - Metal Bar Grating Manual; The National Association of Architectural Metal Manufacturers.


P. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings.


R. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols.
   2. Indicate net weld lengths.

C. Delegated Design Data: As required by authorities having jurisdiction.

D. Welders' Certificates.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Engineer experienced in design of this work and licensed in Tennessee.

B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 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.
B. Metal Jointing and Finish Quality Levels:

1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
   a. Welded Joints: Continuously welded and ground smooth and flush.
   b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
   c. Exposed Edges and Corners: Eased to small uniform radius.
   d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.

2. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit is considered exposed to view.
   a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
   b. Welds Exposed to View: Ground smooth and flush.
   c. Mechanical Joints: Butted tight, flush, and hairline.
   d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
   e. Exposed Edges and Corners: Eased to small uniform radius.
   f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.

3. Service: Exposed joints tight with face surfaces aligned; underside of stair not covered by soffit is not considered exposed to view.
   a. Welded Joints: Welded on back side wherever possible.
   b. Welds Exposed to View: Ground smooth; not required to be flush.
   c. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts or screw threads.
   d. Metal Surfaces to be Painted: Sanded smooth, suitable for satin or matte finish.

4. Industrial: All joints made neatly.
   a. Welded Joints: Welded on back side wherever possible.
   b. Welds Exposed to Touch: Ground smooth.
   c. Bolts Exposed to Touch in Travel Area: No nuts or screw threads exposed to touch.

2.02 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
   1. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
   2. Pan Anchorage to Stringers: Continuously welded, from top or bottom.
   3. Concrete Finish: For resilient floor covering.

D. Risers: Same material and thickness as tread pans.
   1. Riser/Nosing Profile: Vertical riser with underside of nosing sloped up from bottom of tread pan at not less than 60 degrees from horizontal, with rounded top of nosing of minimum radius.
   2. Nosing Depth: Not more than 1-1/2 inch overhang.
   3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inch minimum.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.
F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

G. Railings: Reference Architectural Details.

H. Finish: Shop- or factory-prime painted.

I. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.03 METAL STAIRS WITH METAL TREADS

A. Jointing and Finish Quality Level: Service, as defined above.

B. Risers: Closed.

C. Treads: Checkered steel plate.
   1. Tread Thickness: 1/4 inch, minimum.
   2. Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.

D. Treads: Checkered steel plate.
   1. Tread Thickness: 1/4 inch, minimum.
   2. Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.

E. Risers: Steel sheet.
   1. Riser Thickness: As required by design; 14 gage, 0.075 inch minimum.
   2. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.

F. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

G. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

H. Railings: Steel pipe railings.

I. Finish: Shop- or factory-prime painted.

2.04 METAL STAIRS WITH GRATING TREADS

A. Jointing and Finish Quality Level: Industrial, as defined above.

B. Risers: Open.

C. Treads: Steel bar grating.
   1. Grating Type: Welded.
   2. Bearing Bar Depth: 3/4 inch, minimum.
   3. Top Surface: Standard.
   6. Anchorage to Stringers: End plates welded to grating, bolted to stringers.

D. Stringers: Rolled steel channels.
1. Stringer Depth: 12 inches, minimum
2. End Closure: Sheet steel of same thickness as risers welded across ends.

E. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

F. Railings: Steel pipe railings.

G. Finish: Shop- or factory-prime painted.

2.05 HANDRAILS AND GUARDS

A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
   1. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.

B. Guards:
   1. Top Rails: Round pipe or tube rails unless otherwise indicated.
      a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
   2. Infill at Picket Railings: Vertical pickets.
      a. Horizontal Spacing: Maximum 4 inches on center.
      b. Material: Solid steel bar.
      c. Shape: Square.
      d. Size: 1/4 inch square.
      e. Top Mounting: Welded to underside of top rail.
      f. Bottom Mounting: Welded to top surface of stringer.
   3. Infill at Pipe Railings: Pipe or tube rails sloped parallel to stair.
      a. Outside Diameter: 1 inch.
      b. Material: Steel pipe or tube, round.
      c. Vertical Spacing: Maximum 4 inches on center.
      d. Jointing: Welded and ground smooth and flush.
   4. End and Intermediate Posts: Same material and size as top rails.
      a. Horizontal Spacing: As indicated on drawings.
      b. Mounting: Welded to top surface of stringer.

2.06 MATERIALS

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500 or ASTM A501 structural tubing, round and shapes as indicated.

C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.


E. 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).

F. Checkered Plate: ASTM A786/A786M, rolled steel floor plate.

G. Gratings: Bar gratings complying with NAAMM MBG 531 or NAAMM MBG 532, whichever applies based on bar sizes.
H. Concrete Fill: Portland cement Type I, 3,000 psi, 28-day strength, 2- to 3-inch slump.

I. Concrete Reinforcement: Mesh type as detailed, galvanized.

J. Steel Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.

K. Welding Materials: AWS D1.1; type required for materials being welded.

L. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

M. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.07 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.

1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.

2. Number of Coats: One.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 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.

3.03 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.

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.
3.04 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
SECTION 05 52 15
ILLUMINATED HANDRAIL

PART 1  GENERAL

1.01  SUMMARY

A. This Section includes the following:
   1. Illuminated ornamental railings.

1.02  RELATED SECTIONS

A. Division 26 Sections for electrical service and connections for illuminated railings.

1.03  SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. For illuminated railings, include wiring diagrams and roughing-in details.

B. Product Data: Submit for all items.

1.04  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.

PART 2  PRODUCTS

2.01  MANUFACTURERS

If you choose other .... Then edit

2.02  COMPONENTS

A. Lighting: Low voltage LED based linear light fixture within the handrail

B. Power Supply and Enclosure: Remotely located; Manufacturer's standard.

C. Material/Finish: Brushed stainless steel

D. Size: 1.66 inch O.D.

E. Mounting: Post mounted
F. Provide all power cords, wiring and installation accessories required for a complete installation.

G. Electrical Components: Provide internal, fluorescent light fixtures and electrical components, required as part of illuminated railings, that comply with NFPA 70 and that are listed and labeled by UL.

2.03 ILLUMINATED RAILINGS

A. Illuminated Units: Provide internal illumination using concealed, internally wired, LED fixture system to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service. Coordinate electrical characteristics with those of the power supply provided.

1. LED based linear light fixture: Provide number of tubes indicated or required by railing length.

2. Housing, optical assembly and stainless steel end caps are bonded to prevent water infiltration.

PART 3 EXECUTION

3.01 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

C. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.02 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION
SECTION 05 58 13
COLUMN COVERS

PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide column cover assembly complete with framing studs, brackets and fasteners.

1.02  RELATED SECTIONS

A. Gypsum Board Joint Tape and Compound: Section 09 21 16.

1.03  QUALITY ASSURANCE

A. Manufacturer to have a minimum of ten years experience in the manufacturing of column covers.

1.04  SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details.
   1. Include plans, elevations, component details, and attachments to other work.
   2. Indicate materials and profiles of each member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

1.05  DELIVERY, STORAGE AND HANDLING

A. Protect all material during fabrication, shipment, site storage and erection to prevent damage to the finished work from other trades.

B. Store column covers inside a well ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling and abrasion.

PART 2  PRODUCTS

2.01  COLUMN COVERS

A. Cover: Minimum .090" thick rolled aluminum sheet, alloy 5052-T5 or 3003-H14 alloy. Provide with tapered or recessed joint flanges to permit flush finishing of joints using conventional gypsum board type tape and compound and techniques.

B. Framing (Posts) and Brackets: Manufacturer's standard metal type. Locate as back-up to joints.
C. Finish: Mill finish aluminum.

D. Manufacturer: Series 100 by PITTCON INDUSTRIES, INC.; Series FF by FRY REGLET; HJ Series by MM SYSTEMS.

2.03 FABRICATION

A. Provide column covers to specific dimensions and tolerances, and accurately formed to radii indicated.

B. Fabricate in two vertically divided sections attached with a field taping joint.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect column covers upon receipt to ensure that no damage has occurred during shipment.

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Correctly orient and install in accordance with manufacturer’s shop drawings and installation instructions to ensure proper installation.

C. Erect plumb and level.

D. Finish column joints to a smooth, sanded monolithic surface. Leave columns ready to receive field applied finishes specified.

END OF SECTION
SECTION 06 10 00
ROUGH CARPENTRY

PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide rough carpentry work as shown and specified. Work includes:
   1. Wood framing, nailers, blocking, grounds and furring.
   2. Roof blocking, cants and nailers.
   3. Concealed blocking for support of accessories, equipment, specialty items,
      cabinets, fixtures, trim and facing materials.
   5. Rough hardware and accessory materials.
   7. OSB wall sheathing.
   8. Subflooring.

1.02  RELATED SECTIONS

A. Sustainable Design Requirements: Section 01 81 13.
B. Finish Carpentry: Section 06 20 00.
C. Architectural Woodwork: Section 06 40 00
D. Exterior Sheathing Board: Section 09 21 16.

1.03  REFERENCES

A. Standards
   1. American Plywood Association (APA): Grades and Standards
      a. APA Plywood Design Specification, Form No. Y510T.
      b. APA Engineered Wood Construction Guide, Form No. E30R.
      a. AWPA U1 - Use Category System: User Specification for Treated
         Wood
   3. PS - U.S. Product Standard: Softwood Lumber and Plywood Standards
      a. PS-1 - Construction and Industrial Plywood.
         and Steel Hardware
      b. D3498 - Standard Specification for Adhesives for Field-Gluing
         Plywood to Lumber Framing for Floor Systems
      c. D2898 - Standard Practice for Accelerated Weathering of Fire-
         Retardant-Treated Wood for Fire Testing
      d. E84 - Standard Test Method for Surface Burning Characteristics
         of Building Materials
1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings indicating framing connection details, fastener connections and dimensions.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

C. Preservative Treated Wood: Submit certification by treating plant stating chemical and process used and conformance with applicable standards.

D. Fire-Retardant Treatment: Submit certification by treating plant that fire retardant treatment materials comply with governing ordinances and that treatment will not bleed through finished surfaces.

E. LEED Submittals
   1. Certificates for [Credit MR 6] [Credit MR 7]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
   2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
   3. Laboratory Test Reports for Credit IEQ 4: For [adhesives] [and] [plywood], documentation indicating that products 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."

1.05 QUALITY ASSURANCE

A. Softwood Lumber: Grading rules and wood species shall conform with the voluntary Product Standards PS 20 including grading rules of the following associations, as applicable:
   2. Douglas Fir, Western Larch and Hemlock: Western Lumber Grading Rules, published by Western Wood Products Association (WWPA), Standard Grading and Dressing Rules for West Coast Lumber Inspection Bureau (WCLIB) or National Lumber Grades Authority (NLGA).
   3. Western Spruce, Pine and Fir: Western Spruce-Pine-Fir Association (WSPFA) and current Canadian Grading Rules by National Grades Association, Canada.

B. Softwood Plywood: Grading rules and wood species shall conform with Product Standard PS 1.

C. Grade Marks
1. General: Identify all lumber and plywood by official grade mark.
2. Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping, or combination designation, rules under which graded, where applicable and condition of seasoning at time of manufacture.
   a. Type, grade, class and identification index.
   b. Inspection and testing agency mark.

1.06 STORAGE AND HANDLING

A. Store off the ground.
B. Protect from direct contact with the weather.
C. Provide proper ventilation.
D. Adhesives
   1. Do not store adhesives with materials that have a high capacity to absorb VOC emissions (i.e., materials which are woven, fibrous or porous in nature, such as acoustical ceilings, carpets, textiles, etc.).
   2. Do not store adhesives in occupied spaces.

1.07 JOB CONDITIONS

A. Time delivery and installation of carpentry work to avoid delaying trades whose work is dependent on, or affected by, the carpentry work and to comply with protection and storage requirements.
B. Installer must examine the surfaces and supporting structure and the conditions under which the carpentry work is to be installed, and notify the Contractor in writing of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
C. Correlate location of furring, nailers, blocking, grounds and similar supports so that attached work will comply with design requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Dimension Lumber - General
   1. Nominal sizes are indicated, except as shown by detailed dimensions. Provide lumber complying with lumber producer's inspection agency grading rules certified as conforming to the "National Grading Rule for Dimension Lumber," by Board of Review of the American Lumber Standards Committee (ALCS), established under Section 10 of PS 20.
   2. Dress dimension lumber S4S unless otherwise shown or scheduled.
3. Provide seasoned dimension lumber with 19% maximum moisture content at time of dressing and complying with the dry size requirements of PS 20. Mark lumber "S-DRY".
   a. 15% maximum moisture content for fire-retardant wood.

4. Provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

   B. Light Framing Lumber: Where framing lumber from 2" through 4" thick, and 4" or less wide is indicated, provide lumber complying with the specified requirements for dimension lumber and with the following grading, unless otherwise indicated:
   1. Provide "Construction" grade light framing and mark "CONST".
   2. Where stud framing is shown, provide "Stud" grade lumber and mark "STUD".

   C. Structural Framing Lumber: Where framing lumber, including studs, 6" and wider, and from 2" through 4" thick is indicated, provide lumber complying with the specified requirements for dimension lumber and with the following:
   1. Specie and Grade: No. 1 grade (Structural Rafters and Planks) Douglas Fir (WCLB or WWPA) or Southern Yellow Pine (SPIB) which meets or exceeds the following values:
      a. Fb (minimum extreme fiber stress in bending): 1,150 psi.
      b. E (minimum modulus of elasticity): 1,400,000 psi.
   2. All structural lumber shall comply with the minimum stress requirements indicated on the structural drawings.

   D. Miscellaneous Lumber
   1. Provide wood for support or attachment of other work such as cant strips, nailers, blocking, furring, grounds, bucks, stripping and similar members. Provide lumber of the sizes shown or specified, worked to shapes shown and as follows:
      a. Specie: Any commercial softwood, construction grade.

   E. Plywood: Provide exterior grade plywood for exterior use and interior type with exterior glue for interior use. Formaldehyde free.
   1. Concealed Use
      a. Exterior: APA-CD-EXT.
   2. Exposed Interior Use - Painted Finish: APA MEDIUM DENSITY OVERLAY (MDO).
   3. Roof Sheathing: APA RATED SHEATHING EXT, square edge.
   4. Subfloor: APA RATED STURD-I-FLOOR EXP 1 or 2.
   5. Backing Panels: APA CD PLUGGED INT with exterior glue, square edge.
   6. Underlayment: APA UNDERLAYMENT EXP 1, with sanded-face.

   E. OSB Panels (Oriented Strand Board): Conform to PS-2 and HUD/FHA Materials Bulletin 40C. Formaldehyde free.
   1. Roof Sheathing
      a. Thickness: 9/16".
      b. Exposure Durability Classification: Exposure 1.
   2. Wall Sheathing
2.02  FIRE-RETARDANT WOOD TREATMENT

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. After treatment, kiln-dry lumber to maximum 19% moisture content and plywood to maximum 15% moisture content. Inspect each piece of lumber and plywood after drying and discard damaged or defective pieces.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

2.03  PRESERVATIVE WOOD TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each piece of treated lumber with AWPB Quality Mark designation denoting conformance to the appropriate specification.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, [furring,] [stripping,] and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawl spaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.04 ROUGH HARDWARE

A. General: Provide all necessary spikes, screws, nails, bolts and other hardware for satisfactory erection of work. Except where noted to be stainless steel, provide hot-dipped galvanized finish for hardware exposed to exterior, located in toilet rooms, in contact with treated wood or in contact with roofing or flashing.

1. Nails: ASTM F1667. Common wire nails, except where noted otherwise on drawings; sizes as noted or specified herein.
   a. Subflooring: Deformed shank nails.
2. Attachment to Concrete or Masonry: Metal expansion type shields or inserts; sizes as required to accommodate applied fastener; spacing as indicated on drawings.
   a. "DH" or "Ankr-Tight" by WEJ-IT or equal by RED HEAD or HILTI.
   b. Sleeve type for masonry.
   c. Wedge type for concrete.
3. Adhesive Type Anchor Bolts – In Hollow CMU: Chemically grouted adhesive anchor systems with nylon or stainless steel screen inserts. Use 1/2 inch diameter anchors, unless otherwise noted.
   a. HIT HY20 Adhesive Anchors, HILTI, INC.
   b. EPCON System, ITW/RAMSET/RED HEAD
   c. Chem-Stud Adhesive Anchors, RAWLPLUG COMPANY, INC.
   d. Simpson Set Epoxy-Tie Adhesive Anchors, SIMPSON STRONG-TIE COMPANY, INC.
4. Adhesive Type Anchor Bolts - In solid grouted CMU and Concrete: Chemically grouted adhesive anchor systems. Use ¾ inch diameter anchors, unless otherwise noted.
   a. HIT HY150 Adhesive Anchors, HILTI, INC.
   b. EPCON System, ITW/RAMSET/REDHEAD
   c. Chem-Stud Adhesive Anchors, POWERS FASTENERS, INC.
   d. Simpson Set Epoxy-Tie Adhesive Anchors, SIMPSON STRONG-TIE COMPANY, INC.
5. Attachment to Steel Studs: Self tapping screws of sufficient length and strength to perform the functions for which they are used.
6. Roof Construction
   a. Wood-to-Wood Attachment: 300 Series stainless steel, flat head.
1) Plywood to Nailers: Minimum #8 x 1-3/4".

b. Wood-to-Metal Deck Attachment: Hot dip galvanized in accordance with ASTM A153; machine bolts, locknuts and washers; minimum 3/8" diameter.

c. Wood-to-Concrete Attachment: 300 Series stainless steel expansion anchors as specified above. Minimum 3/8" diameter, length as required for minimum 2" concrete embedment.

B. Provide plates, anchors, hangers and other miscellaneous steel and iron shapes as required for framing and supporting woodwork and for anchoring or securing woodwork to concrete or wood structures.


   a. Use for interior locations unless otherwise indicated.

2. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A653; 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 coating designation; and not less than 0.036 inch thick.

   a. Use for wood-preservative-treated lumber and where indicated.

3. Manufacturers: Provide products by one of the following:

   a. SIMPSON STRONG-TIE COMPANY
   b. CLEVELAND STEEL SPECIALTY COMPANY
   c. USP STRUCTURAL CONNECTORS
   d. PHOENIX METAL PRODUCTS

2.05 MISCELLANEOUS ITEMS

A. Adhesives: Water- and mold-resistant formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

[1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).]

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

C. Sill Sealer: 3/8" thick by width required, self adhered close cell polyethylene foam sill sealer.

PART 3 EXECUTION

3.01 INSTALLATION

A. General

1. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate the
work with a minimum of joints or the optimum jointing arrangement.

2. Fit carpentry work to other work. Scribe and cope as required for accurate fit.

3. Set wood framing accurately to required lines and levels.

4. Provide framing members of sizes and at spacing shown, and frame openings as shown, or if not shown, comply with the recommendations of the "National Design Specifications for Wood Construction and Supplements" as published by the American Wood Council.

5. Cut, join and tightly fit framing around other work.

6. Do not splice structural members between supports unless otherwise detailed.

7. Anchor and nail as indicated, or if not indicated to comply with the "Fastening Schedule" of the IBC, 2304.9.

8. Fasteners
   a. Use common wire nails, except as otherwise shown or specified herein.
   b. Use finishing nails for exposed work.
   c. Do not wax or lubricate fasteners that depend on friction for holding power.
   d. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials.
   e. Make tight connections between members.
   f. Install fasteners without splitting of wood; predrill as required. Do not drive threaded friction type fasteners; turn into place.
   g. Tighten bolts and lag screws at installation and retighten as required for tight connections prior to closing in or at completion of work.
   h. Countersink nail heads on exposed carpentry work and fill holes.
   i. Provide washers under bolt heads and nuts in contact with wood.

9. Nail plywood to comply with the recommendations of the American Plywood Association and OBC 2304.9.

10. Provide sill plates where wood framing is supported by concrete or masonry walls or piers. Anchor to embedded bolts as shown.

11. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

B. Stud Framing: Provide stud framing where shown. Erect on lines shown, to true planes, plumb, level and rigidly secured. Use 2" by 4" studs spaced at 16" on center, except as otherwise indicated. Cut wood framing square at bearing.

1. Provide single bottom plate and double top plates, 2" thick and of same width as studs. Overlap top plates at corners and intersections. Single top plate may be used for non-bearing partitions.

2. Construct corners and intersections of partitions and walls with not less than three studs 2" thick, to provide bearing surface for wall finishes.

3. Provide blocking and framing, same width as studs, required for support of facing materials, fixtures, specialty items, trim, cabinets, drapery hardware and accessories. Blocking and framing for subsequently applied work shall be reviewed and be acceptable to the Architect before installation of finish materials.

4. Framing openings with double studs (triple studs for openings wider than 6'-0") and headers of double members of thickness equal to width of studs.
Set headers on edge and support on jamb studs. Provide headers of depth shown.

5. Notch framing for wiring and piping as required. No cut or hole may exceed 40% of the stud cross sectional area. Install steel plates at stud face notches to prevent drywall fastener damage.

6. Provide plywood sheathing or OSB at building corners; extend 4' on each side of corner.

C. Joists: Provide joist framing of sizes and spacing shown.
1. Install with crown edge up and support ends of each member with not less than 1-1/2" of bearing on wood.
2. Attach to wood bearing members by toe nailing or metal connectors; frame to wood supporting members as shown, if not shown, with metal connectors.
3. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 4'-0".
4. Do not notch in middle third of joists; limit notches to 1/6 depth of joist, 1/3 at ends. Do not bore holes larger than 1/3 depth of joist or locate closer than 2" from top or bottom.
5. Provide solid blocking (2" thick by depth of joist) at ends of joists unless nailed to header or brace member.
6. Lap members framing from opposite sides of beams, girders, or partitions not less than 4" and securely tie opposing members together. Provide solid blocking (2" thick by depth of joist) over supports.
7. Cross bridge between joists 8'-0" on center maximum with 1" by 3" double crossed boards, 2" thick solid wood or suitable metal bridging.

D. Rafters: Provide member size and spacing shown.
1. Notch to fit exterior wall plates and toe nail or use special metal framing anchors.
2. Double rafters to form headers and trimmers at openings in roof framing (if any), and support with metal hangers.
3. Where rafters abut at ridge, place directly opposite each other and nail to ridge members or use metal ridge hangers.

E. Provide all special framing as indicated or required for eaves, overhangs and similar conditions to maintain the profiles indicated on the building plans, sections and elevations. If specific large scale details are not indicated on the drawings, the profiles indicated on smaller scale elevations and plans will govern.

F. Provide fire stops and fire separations in roof areas as required by applicable code requirements.

G. Wood Grounds, Nailers and Blocking
1. Provide wherever shown and where required for screeing or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached or screeed.
2. Coordinate location with other work; refer to shop drawings of such work, if any.
3. Attach to surfaces securely with anchor bolts or other attachment devices
as shown, and as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry as work progresses, cutting to fit masonry unit size involved. Anchor to formwork before concrete placement.

4. Provide grounds of dressed, key-bevelled lumber not less than 1-1/2" wide and of the thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required. Where indicated as permanent grounds, provide treated lumber.

5. Anchor plates, blocking, nailers, etc. to masonry and concrete masonry units (units with cores grouted solid) with minimum 1/2" diameter fasteners spaced at 4’ o.c., unless otherwise indicated. Situations requiring special bolting shall be with size and spacing of bolts as required.

3.02 SHEATHING

A. Wall Sheathing, Roof Sheathing and Subflooring: Provide where indicated. Comply with applicable recommendations contained in Form No. E30R "APA Engineered Wood Construction Guide", for types of plywood products and applications indicated.

1. General
   a. Install panels across supports, using panels continuous over two or more spans, with end joints staggered and located over center of supports. Provide 1/8" space at edges for expansion/contraction.
   b. Nail at 6" on center along panel ends and 12" on center at intermediate supports.

2. Subflooring
   a. Use adhesives complying with APA Specification AFG-01, applied in accordance with manufacturers’ recommendations. Apply to all framing member/plywood panel joints.
   b. Provide ply-clips or similar Architect approved support methods at unsupported panel edges.

3.03 MISCELLANEOUS INSTALLATIONS

A. Backing Panels: Provide plywood backing panels for electrical and telephone equipment where indicated.
   1. Provide fire-retardant material at interior locations.
   2. Provide preservative treated material at exterior locations.

B. Underlayment: Install where indicated over subflooring. Install with construction adhesive in accordance with manufacturer’s recommendations, staggering all joints with subflooring joints. Supplement adhered connections with mechanical fasteners.
   1. Where underlayment is being installed over existing wood subflooring, insure that existing subflooring is tight and secure. Add blocking and screws as required.

3.04 WOOD TREATMENT

A. Preservative Treated Wood Products: Provide pressure treatment for all lumber and plywood as specified hereinbefore.
1. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   a. Use inorganic boron for items that are continuously protected from liquid water.
   b. Use copper naphthenate for items not continuously protected from liquid water.

B. Fire Retardant Treated Wood Products: Provide fire retardant treatment on all lumber and plywood as specified hereinbefore.

3.05 CLEANING

A. Clean up debris and cuttings daily. Remove and dispose of excess materials and debris created by carpentry.

B. Maintain the building and site free of accumulations of cutting and waste materials in a neat orderly condition acceptable to the Architect.

3.06 WASTE MANAGEMENT

A. Do not burn scraps of treated wood. Do not mix treated wood scraps with untreated wood. Hazardous wastes shall be separated, stored, and disposed of according to local regulations.

END OF SECTION
PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide finish carpentry as indicated and specified. Work includes:

1. Hardwood running and standing trim.
2. Softwood trim.
3. Exterior trim.
4. Shelving and accessories.
   a. Utility shelving (janitor closets), painted finish.
   b. Adjustable shelving, painted finish.
   c. Fixed shelving and coat rod, painted finish.
5. Interior wood ceilings.
6. Prefinished wood paneling.
7. Wall/door mounted coat hooks.
8. Wood benches, wall mounted.
9. Installation of shop fabricated millwork.
10. Installation of door hardware, door frames and doors.
11. Miscellaneous fasteners and hardware.

1.02  RELATED SECTIONS

A. Rough Carpentry: Section 06 10 00.

A. Wood Blocking: Section 06 10 50.

B. Architectural Woodwork: Section 06 40 00.

C. Hollow Metal Doors and Frames: Section 08 11 13.

D. Wood Doors: Section 08 14 00.

E. Door Hardware: Section 08 71 10.

F. Painting and Finishing: Section 09 91 00.

G. Plastic Laminate Casework: Section 12 32 16.

H. Sustainable Design Requirements: Section 01 81 13.

1.03  REFERENCES

A. Standards: Wherever the following abbreviations are used herein, they shall refer to the corresponding standard:
2. AWI: Architectural Woodwork Institute.

1.04 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. Submit samples of all finish materials, include the following:
   1. Lumber with transparent finish for each species and cut. (three pieces, 12")
   2. Lumber with opaque finish. (12")
   3. Prefinished wood paneling (12" x 12").
   4. Hardwood plywood with transparent finish for each species (three pieces, 12" x 12")

C. Manufacturer's product data describing type and quality of items specified herein.

D. Certification that fire-retardant treatment materials comply with governing ordinances and meet or exceed ASTM E84 tests. Include certification by treating plant that treatment will not bleed through finish surfaces. Materials shall bear UL label showing Flame Spread 25 or less and smoke developed 40 or less. Mill certification is not acceptable.

E. LEED Submittals
   1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
   2. Certificates for [Credit MR 6] [Credit MR 7]: Chain-of-custody certificates indicating that composite wood products comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
   3. Product Data for Credit IEQ 4.1: For adhesives and glues used at Project site, documentation including printed statement of VOC content.
   4. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
   5. Laboratory Test Reports for Credit IEQ 4: For [adhesives] [and] [composite wood products], documentation indicating that products 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."

1.05 QUALITY ASSURANCE

A. Installation: Performed only by experienced skilled finish carpenters.
B. Provide lumber factory marked with type, grade, mill and grading agency identification on concealed surfaces. Omit marking and submit mill certificates for materials to receive transparent finishes that cannot be marked on a concealed surface.

C. Fire-retardant treated wood shall conform to applicable requirements of AWPA and NFPA.

D. Quality Grade: Materials and fabrication shall be "custom grade" in accordance with "Quality Standard Illustrated," of the AWI conforming to the following sections:

1. Section 100: Solid wood members.
2. Section 300: Standing and running trim.
3. Section 500: Paneling.
4. Section 600: Closet and storage shelving.
5. Section 1700: Installation of architectural woodwork.

E. Bench Mark: Before beginning both prefinished paneling work and custom paneling work, construct full scale corner condition extending 6'-0" each direction for custom type and full column width each direction for prefinished type; demonstrating joint construction, materials and general workmanship, including trim work.

1. Approved bench mark will establish minimum standards of quality and workmanship for Architectural Woodwork.
2. Construction Manager will coordinate location of bench mark for each type of paneling. When Construction Manager approves bench mark, construction on the paneling can continue and bench mark can be incorporated into the final work.

1.06 DELIVERY, STORAGE AND HANDLING

A. Do not deliver materials until concrete, masonry and other similar wet work has been completed and is thoroughly dry, outside door openings are permanently watertight, exterior windows are glazed and, in case of temperature dropping below 60 degrees F., until temporary heating and ventilating systems are in operation.

1. Do not store adhesives with materials that have a high capacity to absorb VOC emissions (i.e., materials which are woven, fibrous or porous in nature, such as acoustical ceilings, carpets, textiles, etc.).
2. Do not store adhesives in occupied spaces.

B. Protect finish carpentry during delivery, storage and handling to prevent damage, soiling and deterioration.

C. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.07 PROJECT CONDITIONS
A. Provide and maintain a constant temperature and humidity before, during and after installation as required to maintain optimum moisture content of installed materials.

B. Obtain measurements and verify dimensions and details before proceeding with finish carpentry.

C. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.01 MATERIALS

[A. General

1. Provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship".

2. Regional Materials: Provide wood products manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.]

B. Lumber

1. Provide lumber surfaced four sides (S4S) and worked to profiles and patterns shown. Nominal sizes are as shown, except where detailed dimensions are indicated.

2. Moisture Content: Provide materials kiln-dried to moisture content complying with AWI Standards, Section 100-G-3.

   a. Western Red Cedar, Ponderosa Pine, White Pine: Western Lumber Grading Rules, published by Western Wood Products Association (WWPA), or Standard Grading Rules for West Coast Lumber, No. 16, published by West Coast Lumber Inspection Bureau (WCLIB).

C. Wood Trim - Stained Finish: In accordance with AWI 300, "Custom" Grade, and AWI 100, Grade I, except no checks will be allowable on visible surfaces. [Rift sawn] [Quarter sawn] [Plain sliced] [white oak] [red oak]. Well seasoned and kiln dried. Moisture content at time of fabrication shall not exceed 12%.

D. Wood Trim - Painted Finish: In accordance with AWI 300, "Custom" Grade, and AWI 100, Grade I, except no checks will be allowable on visible surfaces. Plain sliced poplar. Well seasoned and kiln dried. Moisture content at time of fabrication shall not exceed 12%.
E. Softwood Plywood: Thickness as indicated. Formaldehyde free.
   2. Exposed Interior Use - Painted Finish: APA MEDIUM DENSITY OVERLAY (MDO).

F. Hardwood Plywood: "Custom" Grade, in accordance with AWI 200, Grade I (one-side or two side as required). MDF fiberboard core typical except veneer core permitted for thickness less than 1/2". Species to match hardwood finish lumber, quarter sawn/plain sliced. Thickness as indicated. Maximum moisture content of 6%. Formaldehyde free.

G. Prefinished Wood Paneling System: Provide system consisting of system design, panels, extruded aluminum mounting system and trim, and accessories for a complete installation. No exposed joint trim is permitted at panel-to-panel horizontal and vertical joints. Formaldehyde free.
   1. Finish
      a. Class A Smoke Spread and Smoke Developed in accordance with ASTM E84.
      c. Meets ANSI and AHA Standards for pre-finishing paneling
      d. AWI Finish System TR-4 Custom grade finish.
   2. Panel Colors and Wood Species: As indicated on the drawings.
   3. Exposed Trim Finish: [Aluminum; finish as indicated on the drawings] [Clear anodized aluminum].
   4. Manufacturer
      a. Basis of Design: Drawings and specifications are based on Wood Veneer Panels on MAP System 10 Concealed Horizontal and Vertical Spline System by MARLITE.
      b. Other Manufacturers: Products and systems by ARMSTRONG (WoodWorks Custom), LAMIN-ART, VENTEC LTD., GAGECAST or CUSTOM INTERIOR DYNAMICS are acceptable provided the materials and systems meet the requirements of the specifications and the design intent indicated on the drawings.
   5. Accessories
      a. Molding and Trim: Extruded aluminum; pre-finished at the factory; types and shapes as recommended by manufacturer for installation system specified and substrate conditions.
      b. Adhesive: ASTM Specification C557
      c. Silicone Sealant: See Section 07 92 00.

H. Exterior Wood Trim: Western Red Cedar, A Grade.
   1. Shapes and Profiles: As indicated on drawings. [Clarification: Cedar member sizes as indicated on the drawings may be achieved by building shapes using multiple 2x members or facing alternate species with 2x cedar members. Unless otherwise detailed, the face of a built-up member should read as a solid member.]

I. Nails
   1. Provide steel nails with diamond point for soft woods and blunt point for hardwoods.
2. Interior Work - Finishing Nails: 6d for 3/4" material; 9d or 10d for 5/4" material; and 12d for 1-1/2" material.

J. Cork Board: 1/2" thick; flame retardant type.

K. Wood Decking: Kiln dried S4S No. 1 Southern Pine or Douglas Fir; nominal 2 x 6. Provide exterior wood decking and stairs preservative treated in accordance with Section 06 10 00 requirements.

L. Interior Ceiling: Kiln dried No. 2 White Pine; 1 x 6 S4S; ship-lap “V”-groove joints.

M. Wood Benches
   1. Material: Select Northern grown hard maple, kiln dried and seasoned before fabrication.
   2. Fabrication: Edge grain laminated 1” x 1-1/4” strips. Glued under pressure with low VOC water-resistant glue and biscuits. Sanded both surfaces. Round all exposed edges ¼” radius.
   3. Thickness: 1-1/4”.
   5. Support Brackets: Section 05 50 00.

2.02 ACCESSORIES

A. Wood Filler: Oil or solvent base, tint to match surface color.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
   1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Paneling Adhesive: Comply with paneling manufacturer’s written recommendations for adhesives.
   1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.
   1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Utility Shelf Supports: KNAPE & Vogt (KV); Newtech Hardware; Sugatsune America; Spur, steel cadmium plated heavy duty double slotted supports.
   1. Standards: Equivalent to KV #85; unless otherwise indicated 48 inches high, maximum 30 inch spacing.
   2. Brackets: Equivalent to KV #185; unless otherwise indicated, 3 per standard, for 10 inch shelf.

F. Coat Rods: 1-1/16” o.d. chrome plated steel with escutcheons; provide for clear span as follows:
   1. 4 feet: 20 gage.
   2. Over 4 feet to 7 feet: Wall thickness 0.12”.
   3. Over 7 feet: Provide suitable intermediate support.
G. Coat Hooks - Individual Wall/Door Mounted: Similar to Model 901 by RAYMOND ENGINEERING INC. (REI) or equal by PETER PEPPER or VOGEL PETERSON; clear anodized finish.

H. Prefinished Wood Paneling System: Provide system consisting of system design, panels, extruded aluminum mounting system and trim, and accessories for a complete installation. No exposed joint trim is permitted at panel-to-panel horizontal and vertical joints. Formaldehyde free.

1. Finish
   a. Class A Smoke Spread and Smoke Developed in accordance with ASTM E84
   c. Meets ANSI and AHA Standards for pre-finishing paneling
   d. AWI Finish System TR-4 Custom grade finish

2. Panel Colors and Wood Species: As indicated on the drawings.

3. Exposed Trim Finish: Aluminum; finish as indicated on the drawings.

4. Manufacturer
   a. Basis of Design: Drawings and specifications are based on Wood Veneer Panels on System 10 Concealed Horizontal and Vertical Spline System by MARLITE.
   b. Other Manufacturers: Products and systems by ARMSTRONG (WoodWorks Custom), LAMIN-ART, VENTEC LTD., GAGECAST or CUSTOM INTERIOR DYNAMICS are acceptable provided the materials and systems meet the requirements of the specifications and the design intent indicated on the drawings.

5. Accessories
   a. Molding and Trim: Extruded aluminum; pre-finished at the factory; types and shapes as recommended by manufacturer for installation system specified and substrate conditions.
   b. Adhesive: ASTM Specification C557
   c. Silicone Sealant: See Section 07 92 00
   d. Manufacturers: EXTRUDE-A-TRIM, AEROLITE EXTRUSION COMPANY, THERMOPRENE

2.02 FABRICATION

A. General: Except as specified hereinafter, fabricate all work in accordance with AWI quality standards as specified. Work not specified with a level of quality shall be not less than "Custom" quality per AWI.

B. Utility Shelving – Painted Finish: Fabricate from 3/4" MDO plywood; provide [plastic T-edging] [softwood trim edging] on all edges.

C. Adjustable Shelving – Painted Finish: Fabricate from 3/4" MDO plywood; provide softwood trim edging on all edges.

D. Fixed Shelving and Coat Rod – Painted Finish: Fabricate from 3/4" MDO plywood; provide softwood trim edging on all edges.

E. Standing and Running Trim: Fabricate to dimensions, profiles and details indicated.
1. Cut moldings, wood door and window frames, trims and stops clean and sharply defined. Ease edges to approximately 1/16" radius, unless otherwise shown.

2. Machine sand all flat work, except items to receive resawn surfaces.

3. Trim in areas where existing trim remains shall match size and profile of existing trim.

F. Coat Hooks: Provide one coat hook mounted on wall or back side of door to all private toilet rooms and offices, as directed by Architect. Provide hooks mounted to wood trim where indicated.

G. Wood Paneling: Mill and assemble pieces to conform to the profiles and shapes indicated on the drawings. Field stain in accordance with section 09 91 00.

PART 3 EXECUTION

3.01 PREPARATION

A. Condition finish carpentry materials and products to average prevailing humidity conditions in installation areas before installing.

B. Install blocking and anchoring devices built into substrates for anchorage of finish carpentry items.

C. Verify mechanical, electrical, and building items affecting this Section are placed and ready to receive this work.

D. Verify field dimensions.

E. Backprime lumber for painted finish exposed on the exterior or to moisture and high relative humidity on the interior. Comply with requirements of Section 09 91 00.

F. Ventilation for Adhesives: Comply, at a minimum, with the adhesive manufacturers' recommendations for space ventilation during and after installation. Maintain the following ventilation conditions during the adhesive curing period or for 72 hours after installation (whichever is longer): 1) supply 100% outside air 24 hours a day; 2) supply airflow at a rate of 6 air changes per hour, when outside air temperatures are between 55°F and 85°F and humidity is between 30% and 60%; and 3) supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated in the previous item 2.

3.02 INSTALLATION

A. Discard material which is unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate work with minimum of joints or optimum jointing arrangements.

B. Install finish carpentry materials and products plumb, level, true and straight with no distortion. Shim as required using concealed shims. Install to a tolerance of 1/8" in
8'-0" for plumb and level, and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offsets in revealed adjoining surfaces.

C. Scribe and cut work to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Standing and Running Trim: Install with minimum number of joints possible; using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners and comply with Quality Standards for joinery.

E. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk concealed fasteners and blind nailing as required for a complete installation. Use fine finishing nail for exposed nailings, countersunk and filled flush with woodwork.

F. Benches

1. Install wood cleats at each end and back edge of benches.
2. Secure bench top to wood cleats.

3.04 CLEANING AND PROTECTION

A. Repair damaged and defective finish carpentry materials to eliminate functional and visual defects. Where not possible to repair properly, replace finish carpentry as directed by the Architect.

B. Protect installed work during remaining construction operations.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch-up shop applied finishes to restore damaged or soiled areas.

END OF SECTION
SECTION 06 40 00

ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide architectural woodwork as indicated and specified. Work includes:

1. Custom case work. Provide in the following areas:
   a. Reception Room XXX.
   b. Bookstore Room XXX.
   c. All other plastic laminate casework: Section 12 33 55.

1. Casework. Include the following:
   a. Custom type as detailed on the drawings.
   b. Modular type plastic laminate clad casework and components.
       Work includes fabrication and installation of standard base and wall
cabinet components, shelving, fillers and panels.

2. Plastic laminate window stools.

3. Plastic laminate countertops.

4. Solid surfacing countertops.

5. Solid surfacing window stools.

6. Quartz composition countertops.

7. Laminated glass countertops

8. Shelving and accessories.
   a. Adjustable shelving, plastic laminate finish.
   b. Fixed shelving and coat rod, plastic laminate finish.

9. Wire supported glass shelving.

10. Miscellaneous fasteners and hardware.

1.02 RELATED SECTIONS

A. Rough Carpentry: Section 06 10 00.

A. Wood Blocking: Section 06 10 50

B. Finish Carpentry: Section 06 20 00.

C. Painting and Finishing: Section 09 91 00.

D. Plastic Laminate Casework: Section 12 33 55.

E. Sustainable Design Requirements: Section 01 81 13.

1.03 REFERENCES

A. Standards: Wherever the following abbreviations are used herein, they shall refer
to the corresponding standard:


2. AWI: Architectural Woodwork Institute.
3. NEMA: National Electrical Manufacturer's Association.

1.04 SUBMITTALS

A. Product Data: Submit for all items.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Provide large scale details.
   2. Indicate methods of fabrication, edging, location and construction of joints.
   3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

C. AWI Quality Standards: A photo-copy of the applicable portions of the AWI publication "Architectural Woodwork Quality Standards", latest edition, shall be submitted with each set of shop drawings.
   1. Each copy must be marked to clearly show all details, specifications and finishes proposed for this work.

D. Submit samples of all finish materials, including the following:
   1. Plastic laminate for texture and color selections. (8” x 10”).
   2. Cabinet hardware (1 of each type).
   3. Lumber with transparent finish for each species and cut. (12”)
   4. Wood veneer faced panel products with transparent finish (12” x 24”).
   5. Solid surface material.

E. Manufacturer's product data describing type and quality of the following:
   1. Plastic laminate (face grade and liner grade).
   2. Cabinet hardware (each type).

F. Submit certification that fire-retardant treatment materials comply with governing ordinances and meet or exceed ASTM E84 tests. Include certification by treating plant that treatment will not bleed through finish surfaces. Materials shall bear UL label showing Flame Spread 25 or less and smoke developed 40 or less. Mill certification is not acceptable.

G. LEED Submittals
   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
   2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
   3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[and regionally
extracted and manufactured] materials. Include statement indicating cost for each regionally manufactured material.

a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.

b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.

4. Certificates for [Credit MR 6] [Credit MR 7]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.

5. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products 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."

6. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products 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."

1.05 DEFINITIONS

A. Exposed Portions of Casework: Include surfaces visible when doors and drawers are closed. Bottoms of casework more than 4 feet above floor and tops less than 6 feet 6 inches above floor shall be considered as exposed. Visible members in open cases or behind glass doors also shall be considered as exposed portions.

B. Semi-Exposed Portions of Casework: Includes those members behind opaque doors, such as shelves, divisions, interior faces of ends, case back, drawer sides, backs and bottoms, and back face of doors. Tops of casework 6 feet 6 inches or more above floor shall be considered semi-exposed.

C. Concealed Portions of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

1.06 QUALITY ASSURANCE

A. Fabricator qualifications: A firm specializing in the fabrication of millwork with a minimum of 5 years experience and a satisfactory record of performance on projects of comparable size and quality. Shop is a certified participant in AWI's Quality Certification Program.

B. Installation: Performed only by skilled finish carpenters with a minimum of 3 years experience in installing custom millwork similar to that required for this project.
C. All solid surface material type work shall be performed by a Manufacturer Certified fabricator.

D. Provide lumber factory marked with type, grade, mill and grading agency identification on concealed surfaces. Omit marking and submit mill certificates for materials to receive transparent finishes that cannot be marked on a concealed surface.

E. Quality Grade: Materials and fabrication shall be "custom grade" unless otherwise indicated on the drawings or specified herein as "premium grade", both in accordance with "Quality Standard Illustrated," of the AWI conforming to the following sections:
   1. Section 100: Solid wood members.
   2. Section 200: Plywood and particleboard.
   3. Section 400: Casework and tops.
   4. Section 500: Paneling.
   5. Section 1500: Factory finishing.

F. Mock-up: Before beginning "matched panel" work construct full scale corner condition extending 8'-0" (minimum) each direction, demonstrating veneer grain matching, joint construction, range of color and general workmanship, including trim work.
   1. Approved mock-up will establish minimum standards of quality and workmanship for Architectural Woodwork.
   2. Mock-up shall remain on site until completion and acceptance of paneling work. When coordinated with Architect, mock-up may be incorporated into the final work.

1.07 DELIVERY, STORAGE AND HANDLING

A. Protect woodwork materials and items during delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver woodwork materials and items until concrete, masonry, painting, grinding and other similar wet work has been completed and is thoroughly dry, outside door openings are permanently watertight, exterior windows are glazed and, in case of temperature dropping below 60° F., until temporary heating and ventilating systems are in operation.

C. Store materials in dry, well-ventilated spaces with constant minimum temperature of 60° F., and maximum relative humidity of 55%.
   1. Do not store adhesives with materials that have a high capacity to absorb VOC emissions (i.e., materials which are woven, fibrous or porous in nature, such as acoustical ceilings, carpets, textiles, etc.).
   2. Do not store adhesives in occupied spaces.

1.08 PROJECT CONDITIONS

A. Provide and maintain a constant temperature and humidity before, during and after installation as required to maintain optimum moisture content of installed materials.
B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.09 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Certified Wood: Provide interior architectural woodwork produced from wood certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

B. Lumber
   1. Provide lumber surfaced four sides (S4S) and worked to profiles and patterns shown. Nominal sizes are as shown, except where detailed dimensions are indicated.
   2. Moisture Content: Provide materials kiln-dried to maximum moisture content of 6% complying with AWI Standards, Section 100-G-3.
      a. Western Red Cedar, Ponderosa Pine, White Pine: Western Lumber Grading Rules, published by Western Wood Products Association (WWPA), or Standard Grading Rules for West Coast Lumber, No. 16, published by West Coast Lumber Inspection Bureau (WCLIB).
   4. Species: Fabricator's option.

C. Hardwood Lumber: In accordance with AWI 300, "Custom" Grade, and AWI 100, Grade I, except no checks will be allowable on visible surfaces. Well seasoned and kiln dried. Moisture content at time of fabrication shall not exceed 6%.
   1. Species and Cut: As indicated on casework details.
      1. Species and Cut
         a. [Rift sawn] [Quarter sawn] [Plain sliced] [white oak] [red].
b. Plain sawn hard maple [natural] [select white].

D. Softwood Plywood: Thickness as indicated. Formaldehyde free.
   2. Comply with PS-1, "Construction and Industrial Plywood".

E. Hardwood Plywood: "Custom" Grade, in accordance with AWI 200, Grade I (one-side or two side as required). MDF fiberboard core typical except veneer core permitted for thickness less than 1/2". Thickness as indicated. Formaldehyde free.
   1. Conform to PS-51.
   2. Species and cut to match hardwood finish lumber.
   2. Species and Cut: As indicated on casework details.

F. Particle Board (Substrate for Laminate Surfaces): High density industrial grade with a minimum density of 45 pounds per cubic foot and a moisture content between 9% maximum and 6% minimum, meeting or exceeding ANSI A208.1 or ASTM D1037; formaldehyde-free. ASTM E84, Class A.
   1. FLAKEBOARD Vesta FR Particleboard
   2. SIERRAPINE Encore FR
   3. PANEL SOURCE INTERNATIONAL Pyroblock Platinum Particleboard

G. Medium Density Fiberboard (MDF): Thickness as specified unless otherwise indicated on Drawings. Maximum moisture content of 8%. Formaldehyde free. Meet the following minimum standards:
   1. Internal Bond: 90 psi.
   2. Modulus of Rupture: 2,500 psi.
   4. Density: Minimum 40 pounds per cubic foot.
   5. Fire Rating: ASTM E84 Class A
      a. Smoke Developed: 95
      b. Flame Spread: 15
   6. Manufacturers
      a. FLAKEBOARD Vesta FR MDF
      b. ROSEBURG FOREST PRODUCTS Medite FR
      c. PANEL SOURCE INTERNATIONAL Pyroblock Platinum MDF

H. Plastic Laminate: Conform to the requirements of the National Electrical Manufacturer's Association (NEMA) Publication Number LD-3. Plastic laminate shall be FORMICA, PIONITE, NEVAMAR or WILSONART. Colors, patterns and finishes shall be as selected by Architect from the manufacturer's full range of standard colors, patterns and finishes.
   1. General Purpose Grade: 0.05 inches thick.
   2. Backing Sheet Grade: 0.02 inches thick.
   3. Post-Forming Grade: 0.042 inches thick.
   4. Cabinet Liner: 0.02 inches thick.
   5. Provide solid color type where indicated on drawings.
   6. Fill and seal plastic laminate joints with Seamfil by KAMPEL ENTERPRISES, INC. or equal. Colors to match plastic laminate.

I. Wood Countertop
   1. Material: Select Northern grown hard maple, kiln dried and seasoned
2. Fabrication: Edge grain laminated 1” x 1-1/4” strips. Glued under pressure with water-resistant glue and biscuits. Sanded both surfaces. Round all exposed edges ¼” radius.

3. Thickness: 1-1/4”.


J. Hardware Items: All exposed hardware to be polished brass, satin brass, satin chrome, polished chrome, brushed nickel finish.

1. Drawer Slides: Self-closing, side mounting type with nylon tire, steel ball-bearing rollers. Manufactured by BLUM, GRASS, AMEROCK, KNAPE & VOGT; ACCURIDE. Load capacity as follows:
   a. 75 pounds: Drawers up to 3-1/2 inches deep: Similar to ACCURIDE Series 2132.
   b. 100 pounds: Drawers up to 8 inches deep: Similar to ACCURIDE Series 2832.
   c. 150 pounds: Drawers over 8 inches deep, all file drawers: Similar to ACCURIDE Series 4034.

2. Drawer and Door locks: 5-pin tumbler, dead bolt. KENSTAN; BEST; NATIONAL LOCK; CORBIN. Provide 2 keys per cylinder.

3. Concealed Hinges: European style, self-closing, type as required for construction. HAFELE; GRASS; PRAMETE; BLUM.


5. Continuous Hinge: Piano type.

6. Drawer and Door Pulls: Wire pull, 5/16” diameter x 3-1/3” long x 1-5/16” extension. STANLEY, GRASS, BLUM, HAFELE.

7. Adjustable Cabinet Shelf Supports – Spoon Type: 5mm; nickel plated.

   a. Standards: KV #255 NP for dado installation.
   b. Clips: KV #256 NP.

9. Surface Mount Shelf Supports: KNAPE & VOGT (KV); NEWTECH HARDWARE; SUGATSUNE AMERICA, steel cadmium plated heavy duty double slotted supports.
   a. Standards: Equivalent to KV #85; unless otherwise indicated 48 inches high, maximum 30 inch spacing.
   b. Brackets: Equivalent to KV #185; unless otherwise indicated, 3 per standard, for 10 inch shelf.

10. Glass Shelf Supports: KNAPE & VOGT (KV); NEWTECH HARDWARE; SUGATSUNE AMERICA, black painted finish standard duty single slot supports.
    a. Standards: KV #80; space as indicated.
    b. Brackets: KV #180; space as indicated.

11. Catches: Magnetic, STANLEY #45 or equal by NATIONAL LOCK or EPCO.

12. Sliding Glass Door Track Assembly: KNAPE & VOGT #992 ZC. Consists of Upper Channel (993), Shoe (995), Ball Bearing Carrier (997), and Lower Track (999).

13. Sliding Glass Cabinet Door Locks: KNAPE & VOGT #963 CHR.

14. Coat Rods: 1-1/16” o.d. chrome plated steel with escutcheons; provide for clear span as follows:
a. 4 feet: 20 gage.
b. Over 4 feet to 7 feet: KNAPE & VOGT #770, wall thickness 0.12”.
c. Over 7 feet: Provide suitable intermediate support.

15. Grommets: High impact ABS cable hole cover, with spring closure or slide closure in top. Color as selected by Architect. Refer to Drawings for locations and sizes. Manufactured by DOUG MOCKETT, BAINBRIDGE MANUFACTURING or US FUTABA.

16. Miscellaneous Items
   a. CPU holder by COMPUTER COMFORTS, INC. #SEC-RACK, locking CPU Holder or equal
   b. Flat screen garage by KI or equal
   c. Pencil drawer by HAWORTH #PPD-18 or equal by KNOLL or ALLSTEEL.
   d. Adjustable keyboard tray by HAWORTH #AKPM-21-SI or equal by KNOLL or ALLSTEEL.
   e. Security lock for computers to be BELKIN Notebook, #918583/F8E550-CMK.

17. Stand-Off Brackets: 1” diameter stainless steel, brushed finish. Similar to 3FORM Point Support or equal by DOUG MOCKETT. ½” deep cap; barrel length as indicated.

18. Additional Items: As indicated on the casework details.

K. Nails
   1. Provide steel nails with diamond point for soft woods and blunt point for hardwoods.
   2. Interior Work - Finishing Nails: 6d for 3/4" material; 9d or 10d for 5/4" material; and 12d for 1-1/2" material.

L. Adhesive: Low-VOC, FS MMM-A-125C, Type II, water- and mold-resistant; complying with required VOC regulations.
   1. VOC Content: The volatile organic compound (VOC) content of adhesives shall not exceed the limits defined in Rule #1168 “Adhesive and Sealant Applications” of the South Coast Air Quality Management District (SCAQMD), of the State of California. All VOC limits are defined in grams per liter, less water and less exempt compounds (determined by U.S. EPA Reference Test Method 24). The VOC limits are as follows:
      a. Water-based contact cement: 250 g/L
      b. Water-based construction adhesive: 100 g/L
      c. Plastic laminate adhesive: 50 g/L

M. Solid Surface Material: 1/2” or 3/4” inch thick sheets.
   1. Provide thicknesses as indicated on the drawings.
   2. Surface burning characteristics in accordance with ASTM E 84: Class I or A, and as follows:
      a. Flame spread: <25.
      b. Smoke developed: <25.
   3. Joints: Provide watertight, fused joints as recommended by manufacturer.
   4. Edge Treatment: As detailed on drawings. Ease all exposed edges not otherwise detailed.
   5. Make field cut-outs as required to install plumbing items and toilet
accessories. See Division 22 and Section 10 28 13.

6. Manufacturer and Color Basis of Design: Corian by DU PONT as indicated on the drawings. Solid surface materials by LG Hi-Macs, FORMICA, Gibraltar by WILSONART or ARISTECH SURFACES as approved by Architect during bidding.

N. Quartz Composition Material: Non porous, scratch and high temperature resistant crushed quartz composition.
1. Thicknesses: As indicated.
2. Flexural properties: ASTM D 790, ASTM C 880
3. Compression strength: ASTM C 170
4. Certified food contact: NSF/ANSI 51 Certified.
5. Surface burning characteristics - ASTM E 84: Class I or A, and as follows:
   a. Flame spread: <25.
   b. Smoke developed: <25.

6. Joints: Provide watertight color matched, fused joints as recommended by manufacturer.

7. Edge Treatment: As detailed on drawings. Ease all exposed edges not otherwise detailed.

8. Colors: As indicated. [As selected by Architect.]

9. Manufacturers/Products: [As indicated]. Zodiac by DU PONT, Viatera by LG, Stilestone by COSENTINO, CEASARSTONE, CAMBRIA.

O. Glass

1. For Doors: Clear float glass, ASTM C1036, Type I, Class 1, quality 93, 1/4" thick unless noted otherwise.
   [1. For Doors: Clear tempered float glass, ASTM C1048, Condition A, Type I, Class 1, quality 93. Kind FT, exposed edges seamed, 1/4 inch thick unless noted otherwise.]
2. For Shelves: Clear tempered float glass, ASTM C1048, Condition A, Style I, Type I, quality 93, Class 1, seamed at edges before tempering, 1/4" thick unless noted otherwise.
3. For Countertops: Decorative laminate safety glass: ASTM C1172, standard application for laminated architectural flat glass. 1" Cracked Glass with holographic Jewels as supplied by SPECIALTY ARCHITECTURAL PRODUCTS Mr. Igor Beaufils, (419) 450-5051.
   a. Edges: Monolithically polished.
   b. Reference: ASTM C1036, Type 1-transparent, quality Q3-glazing select quality.

P. Plastic Laminate - Chemical Resistant Type: Conform to the requirements of the National Electrical Manufacturer's Association (NEMA) Publication Number LD-3, Type GP-HGL. Plastic laminate shall be WILSONART ChemSurf, NEVAMAR Chemarmor or equal by FORMICA or PIONITE. Colors, patterns and finishes shall be as selected by Architect from the manufacturer's full range of standard colors, patterns and finishes.

1. Resistance to reagents: Test with five 0.25 mil drops remaining on surface for 16 hours followed by washing off with tap water, then cleaned with liquid soap and water, dried with soft cotton cloth and then cleaned with naphtha.
a. No change in color, surface texture, and original protectability remaining from test results of following reagents:
98% Acetic Acid, Butyl Alcohol, Acetone, 90% Formic Acid, Benzine, Chloroform, 28% Ammonium Hydroxide, Xylene, Carbon Tetrachloride, Zinc Chloride (Sat.), Toluene, Cresol, Sodium Carbonate (Sat.), Gasoline, Ether, Calcium Hypochlorite (Sat.), Kerosene, Cottonseed Oil, Sodium Chloride (Sat.), Mineral Oil, 40% Formaldehyde, Methyl Alcohol, Ethyl Acetate, Trichlorethylene, Ethyl Alcohol, Amyl Acetate, Monochlorobenzene
b. Superficial effects only: Slight color change, spot, or residue only with original protectability remaining from test results of following reagents:
77% Sulfuric Acid, 37% Hydrochloric Acid, 85% Phenol, 33% Sulfuric Acid, 20% Nitric Acid, Furfural, 85% Phosphoric Acid, 30% Nitric Acid, Dioxane

Q. Acrylic Panels: Laminated unfilled acrylic with embedding material.
1. Manufacturers: LUMICOR, 3 FORM INC., VERITAS.
2. Color and Patterns: As indicated on the drawings.
3. Adhesives and Sealants: As recommended by manufacturer. Conform to adhesive requirements specified herein.
4. Performance Properties
   a. Tensile Strength – ASTM D638: 10,000 psi.
   b. Flexural Strength – ASTM D790: 14,600 psi.
   c. Abrasion Resistance – ASTM D1044
   d. 10 Cycles: Haze 15%
   e. 200 Cycles: Haze 50%
   g. Tensile Impact Strength – ASTM D1822: 20 ft. lbs./in².
5. Thickness: As detailed on the drawings.
6. Acrylic Panel Framing and Support Shapes: Extruded aluminum; powder coat finish; colors indicated. “Versa” and “Frame” by 3 FORM INC. or similar systems by other listed acrylic panel manufacturers. Provide all fittings, closures and hardware for complete assemblies as indicated on drawings.

R. Thermoset Decorative Overlay: Particle board or MDF with surface of thermally fused, melamine impregnated decorative paper complying with Laminating Materials Association (LMA) SAT-1. Formaldehyde free.

Q. Tackable Wallboard
1. Description: ½” thick 7 pcf fiberboard with fabric facing.
2. Fabric: Fabric is based on various manufacturers as indicated on the drawings. Fabric manufactured by other manufacturers will be considered if materials meet the requirements of the Basis of Design and the color and style are acceptable matches as approved by the Architect prior to bid opening. Submit fabric to Architect minimum 14 days prior to bid opening. These additionally approved manufacturers and fabrics will be included by Addendum. An unacceptable color match or style is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.
opening.
3. Locations: Where indicated on casework drawings.

S. Foot Rails: Provide brackets, rails and fittings for rail fabrications indicated on the drawings.
1. Manufacturer: LAWRENCE, BRASS WORKS or equal.
2. Finish: Brushed stainless.
3. Foot Rails
   a. Rails: 1-1/2" o.d. LAWRENCE #915.
   b. End Caps: Flush; match tubing size and finish. LAWRENCE #910.
   c. Brackets: LAWRENCE Combination Type #902.
   d. Provide matching mounting hardware.

T. Wire Supported Glass Shelves: Provide complete system consisting of support wire, fittings and glass shelves.
1. Wire: Stainless steel stranded wire; 3mm diameter.
2. Fittings: Stainless steel.
   a. Wire termination fittings; profile as indicated on drawings. Sized to fit 3mm diameter wire.
   b. Shelf Supports: JAKOB Wire Rope Swivel Cone with Disk, Swaged; sized to fit wire.
3. Glass Shelves: As specified herein, except ¼" thick
4. Manufacturers: JAKOB Inox Line or equal by LOOS AND COMPANY, or DÉCOR CABLE.

U. Sculptured Panels
1. Panel Description: 32 by 32 by 1 inch maximum profile relief, smooth surface solid mineral composite panel containing no retardants, accelerators, release agents, or plastics.

2.02 FABRICATION

A. General: Except as specified hereinafter, fabricate all work in accordance with AWI quality standards as specified. Work not specified with a level of quality shall be not less than "Custom" quality per AWI.

Which ??

B. Custom Casework
1. Quality Standard: Custom Grade per AWI Section 400 and Division 400B.
2. Design and Materials: As detailed.

|B. Custom Casework
1. Quality Standard: Custom Grade per AWI Section 400.
2. "Flush Overlay" design as shown in AWI Architectural Casework Details.
3. Core Materials
   a. Partical Board: Typical for plastic laminated finish materials.
b. Plywood Core: Typical for wood veneered surfaces.
c. Solid Hardwood: Typical for all drawer construction, except drawer faces.
d. Hardboard or Luan Plywood: Drawer bottoms.

4. Plastic Laminate Facing
   a. All exposed surfaces: Plastic laminate, general purpose grade.
      Include on exposed face and edges of all cabinets except where
detailed otherwise on the drawings. Apply to all edges of doors and
drawer fronts. Doors shall have laminate on both faces.
   b. A vinyl catalyzed factory finish (AWI Finish System No. 4) shall be
      applied to all semi-concealed surfaces that do not have a pressure
      laminate finish or a balancing sheet finish. This includes drawer
      interior and drawer sides, ends, edges and adjustable semi-
      concealed shelving.
   c. At Contractor's option, the use of .025" thick cabinet Liner Grade
      laminate and .030" thick Backing sheet grade laminate may be used
      in lieu of AWI Finish System No. 4.

5. All casework material in 3/4" thick, excluding facing material thickness,
   unless otherwise detailed, required for stability, or doors in excess of 48" in
   any dimension. Drawer sides to be 1/2" thick; front and back 3/4"; bottom
   1/4" thick.

6. Adjustable Shelves: Install supports at each end of all shelves and
   intermediate supports at all shelves over 30".

7. Design
   a. Configuration of casework is indicated on drawings.
   b. Detailing and design required to provide rigid, solid and structurally
      adequate casework is the responsibility of the fabricator; all within
      parameters of AWI specifications and as approved by the Architect.
   c. The following conditions require special attention:
      1) Casework exceeding 42" in width between supports.
      2) Sink and/or equipment cutouts and supports.
      3) Countertops exceeding 24" unsupported.
      4) Wall and Ceiling Mounted Casework: Provide integral
         framing in casework of size, strength, and in locations which
         allow unit to be screw attached to proper substrate and
         remain rigidly in place.]

C. Plastic Laminate Countertops and Window Stools

1. Quality Standard: Custom Grade per AWI Section 400.
2. Top Core: Construct tops of 3/4" thick particle board core typical; provide
   exterior grade plywood (Plyform) at counters with sinks (and associated
   splashes) and other locations where indicated on drawings.
   a. Where double layers indicated, glue together to form monolithic 1-
      1/2" thick panel.
3. Splashes: Provide with minimum 1/4" scribe typical.
   [a. Integral coved back splash with permanently attached straight side
      splash coped into backsplash.]
[a. Provide straight splashes where shown; permanently attached to top.]
b. Seal: Prior to permanent attachment of straight splashes to top, seal all joints by setting in continuous bead of clear silicone sealant.

4. Exposed Edges: Build exposed edges to 1-1/2" thick at overhang by attaching continuous strip of core material to bottom side of top.

5. Joints in core, if required, to be fitted with mechanical panel fasteners; spacing not to exceed 12" apart nor more than 3" from outside corners.

6. Finishes: Finish tops, splashes and edges with plastic laminate as follows:
   a. General purpose grade [Solid color type] [Post forming grade]
   b. Balance underside of tops with backing sheets, 0.020".
   c. Finish bottom of all overhangs with laminate.

7. Custom Edges: Finish as indicated on drawings.

8. Edges: Except where cabinet design requires matching laminate edge, provide 3mm PVC on Front & Back Edges, 1mm PVC on Side Edges.

D. Solid Surface [and Quartz Surface] Material Countertops: Fabricate to profiles, sizes and edge conditions indicated on drawings and as directed by manufacturers requirements. Back and side splashes, where indicated, to be fused to top to ensure watertight joint. Where countertops do not have a continuous substrate, locate and provide closure strips to prevent openings from countertop underside to top of support casework.

E. Adjustable Shelving – Plastic Laminate Finish: Fabricate to details indicated; conform to requirements for countertops specified herein.

F. Fixed Shelving and Coat Rod – Plastic Laminate Finish: Fabricate to details indicated; conform to requirements for countertops specified herein.

2.03 SHOP FINISHING

A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.

C. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523:
   1. Grade: Premium.
   2. AWI Finish System: TR-4, conversion varnish.
   3. Stain Colors: As indicated on drawings; Final stain colors as selected by Architect to match approved samples.
   4. Wash Coat for Stained Finish: Apply a vinyl wash coat to woodwork made from closed-grain wood before staining and finishing.
   5. Sheen: Semigloss, 55-75 gloss units.

PART 3 EXECUTION
3.01 PREPARATION

A. Condition architectural woodwork materials, items and products to average prevailing humidity conditions in installation areas before installing.

B. Install blocking and anchoring devices built into substrates for anchorage of architectural woodwork.

C. Deliver inserts and anchoring devices to be built into substrates well in advance of time substrates are to be built.

D. Before installing woodwork, examine shop-fabricated work for completion and back priming.

E. Ventilation for Adhesives: Comply, at a minimum, with the adhesive manufacturers’ recommendations for space ventilation during and after installation. Maintain the following ventilation conditions during the adhesive curing period or for 72 hours after installation (whichever is longer): 1) supply 100% outside air 24 hours a day; 2) supply airflow at a rate of 6 air changes per hour, when outside air temperatures are between 55° F and 85° F and humidity is between 30% and 60%; and 3) supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated in the previous item 2.

3.02 INSTALLATION

A. Quality: Comply with AWI Section 1700.

B. Install woodwork materials and products plumb, level, true and straight with no distortion. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including countertops, window stools and shelves), and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offsets in revealed adjoining surfaces.

C. Scribe and cut work to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Install countertops level, true to alignment, accurately fit to wall conditions and securely fastened to base units and other support systems as indicated.

1. Solid Surface Type Countertops: Form joints using tinted adhesive as recommended by top manufacturer.

E. Casework: Install without distortion so that doors and drawers will fit openings properly and be accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

F. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk concealed fasteners and blind nailing as required for a complete installation. Use fine finishing nail for exposed nailings, countersunk and filled flush with woodwork.
G. Plastic Laminate Wall Covering: Install with adhesive as recommended by plastic laminate manufacturer.

3.03 CLEANING AND PROTECTION

A. Repair damaged and defective millwork to eliminate functional and visual defects. Where not possible to repair properly, replace millwork as directed by the Architect.

1. Chipped, scratched or patched plastic laminate will not be accepted and must be replaced.

B. Clean hardware, lubricate and make final adjustments for proper operation.

C. Protect installed work during remaining construction operations.

D. Clean woodwork on exposed and semi-exposed surfaces. Touch-up shop applied finishes to restore damaged or soiled areas.

E. Cover completed casework with 4-mil polyethylene film protective enclosure, applied in a manner that will allow easy removal and without damage to woodwork or adjoining work. Remove cover immediately before the time of final acceptance.

END OF SECTION
SECTION 07 10 00
WATERPROOFING

PART 1  GENERAL

1.01  WORK INCLUDED

A. Whether indicated on the drawings or not, provide waterproofing in the following applications and areas:
2. Wall areas where floor slab is below grade: Semi-liquid or sheet membrane
3. Utility tunnel walls and top: Semi-liquid or sheet membrane
4. Structural slab at balcony conditions, etc.: Semi-liquid or sheet membrane.
5. Planter walls; on plant side of wall where face of wall on opposite side is exposed to view/weather: Semi-liquid or sheet membrane.
8. Other areas where indicated.

B. Surface preparation, primers, and protective covering.

1.02  RELATED SECTIONS

A. Bituminous Dampproofing: Section 07 11 13: basic foundation protection.
B. Air/Vapor Barriers: Section 07 27 26: for above grade envelope protection.
C. Ceramic tile waterproofing membrane: Section 09 30 00.
D. Building Insulation: Section 07 21 00.
E. Sealants: Section 07 92 00.

1.03  SUBMITTALS

A. Shop Drawings: Submit details of special joint or termination conditions and conditions of interface with other materials. Edge terminations, flashing details, treatment of joint penetrations or projections at large scale. Details shall reference each material, sequence of placement and application procedure.
1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

B. Product Data: Submit for all items. Include construction details, material descriptions, and tested physical and performance properties of waterproofing and manufacturer’s written instructions for evaluating, preparing, and treating substrate.

C. Samples: For each exposed product and for each color and texture specified, including the following products:
1. 8-by-8-inch square of waterproofing and flashing sheet.
2. 8-by-8-inch square of insulation.
3. 4-by-4-inch square of drainage panel.
4. Plaza-deck paver, 4-by-4-inch square, in each color and texture required.

D. Statement of Application: Submit statement signed by Contractor and installer, stating that work complies with these specifications and that the installation methods complied with the manufacturer's printed specifications and instructions for the conditions of installation and use on this project.

E. Applicator's License Certificate: Copy of "Certificate of License" issued to system applicator by manufacturer.

F. Sample warranty.

G. Special Environmental Requirements: Submit product documentation for Waterproofing, indicating VOC Content in accordance with Section 01 81 13:

H. Contamination Profile: Manufacturer shall provide the Installer, Contractor and Owner with a tabular profile of chemicals, solutions, oils, compounds or materials which are injurious to the fluid-applied membrane system. This profile shall be established by generic (or trade name) basis, including those materials normally found to exist in the work environment or likely to occur on this work. The system should not be exposed to materials (directly or indirectly) as established by the Contamination Schedule during application or after completion of the work.

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in the manufacture of specific type of waterproofing membrane systems specified with ten years minimum experience.

B. Installer/Applicator: Company specializing in application of specified waterproofing with five years minimum experience and trained and approved by manufacturer.

C. Obtain primary materials for each waterproofing type required from single manufacturer. Provide secondary materials only as recommended and approved by manufacturer of primary materials.

D. Pre-Waterproofing Conference

1. Contractor: Prior to installation of waterproofing and associated work, schedule and administer a pre-installation meeting at the project site to review the material selections, installation procedure, special details, flashings, coordination, inspection procedures, and protection and repairs.
   a. Attendance: Architect, Contractor, Installer, manufacturers' representatives and trades requiring coordination with the work.
   b. Contractor: Take minutes and provide copies to all attendees.

E. Manufacturer's Representative (primary material manufacturer): Furnish services of manufacturer's technical representative at the job site at the start of installation, periodically as work progresses and after completion as necessary to advise on every phase of the waterproofing work.
1. Install entire system in accordance with the manufacturer's instructions except where more stringent requirements are indicated or specified, then the more stringent requirements shall govern.

F. Contractor: Notify Architect 72 hours in advance of scheduled waterproofing work.

G. Installer to advise General Contractor of finish and curing requirements of concrete surfaces, as relates to application of the waterproofing materials, prior to installation of those substrates.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened packaging fully identified with brands, type, grade, class and other qualifying information including instruction for use and identifying numbers.

B. Storage waterproofing materials in a dry area away from high heat, flames or sparks. Provide weatherproof covering all sides allowing for adequate ventilation.

C. Store protection board flat and off the ground, preferably on a wood platform. Provide weatherproof covering on top and all sides.

D. Store only as much material at point of use as required for each day's work.

E. Handling: Handle all materials in a manner to prevent damage of any kind. Remove damaged material from the site and replace with new specified material.

1.06 JOB CONDITIONS

A. Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate. Surfaces to receive membrane shall be free of water, dew, frost, snow and ice.

B. Ventilation: Provide positive ventilation for enclosed areas continuously throughout the application and for a minimum of 8 hours afterward or until coatings have completely cured.

C. Do not allow waste products (petroleum, grease, oil, solvents, vegetable or mineral oil, etc.) to come in contact with the membrane. Exposures to foreign materials or chemical discharges must be presented to membrane manufacturer for evaluation to determine impact on membrane. See "Contamination Profile" specified under paragraph 1.03G herein.

D. Special Precautions: Allow no open fires or spark-producing equipment in the application area until vapors and fumes have dissipated. Post "No Smoking" signs in area during application and maintain for at least 8 hours following application.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in
which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

B. Installer's Special Warranty: Provide warranty for two (2) years against leaks, failures and defects. Upon notification of such defects, within the warranty period, make necessary repairs and replacements at the convenience of the Owner without additional cost to the Owner.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 PRODUCTS

2.01 MATERIALS

A. Semi-Liquid Applied System

1. Membrane: Elasticized rubberized asphaltic compound, self-bonding to normal substrates, hot poured, quick setting.

2. Physical Properties

a. Water Vapor Permeability - ASTM E96, Procedure E: 0.027 perms.


c. Water Absorption - CGSB 37-GP-50M: Gain in weight 0.35 g maximum. Loss in weight 0.18 g maximum.

d. Penetration - ASTM D5329: At 77 degrees F, maximum 110; at 122 degrees F, maximum 200.

e. Elongation - ASTM D5329: 1000% minimum.

f. Low Temperature Crack Bridging Capability - CGSB 37-GP-50M: No cracking, adhesion loss, or splitting.

3. Miscellaneous Materials: Primer, detail coatings, flashing, bonding adhesive, splicing cement, lap sealant, water cut-off mastic, pipe seals, pourable sealer, and other related items as recommended by MFR.

a. Primer: Cut-back solvent type conforming to ASTM D41.

b. Reinforcing Sheet: EPDM/Butyl laminate sheet in uncut rolls.

1) Heavy Duty: 63 mils.


4. Miscellaneous: As required to complete installation.

5. Manufacturers

a. Liquid Membrane 6125 by AMERICAN HYDROTECH

b. TremProof 6100 by TREMCO

c. CCW-500R by CARLISLE

d. 790-11 by HENRY

B. Sheet Membrane System

1. Membrane: Self-adhering laminated sheet comprised of rubberized asphalt and polyethylene film; minimum 60 mil thickness. Furnish in 36" wide x 60' long rolls with release paper.

2. Physical Properties

a. Tensile Strength, Film - ASTM D882: 5000 psi.
c. Pliability, 180 degree bend over 1" mandrel - ASTM D1970: -25 degrees F.
d. Cycling over 1/4" crack, 100 cycles - ASTM C836: At -25 degrees, no effect.
e. Permeance - ASTM E96, Method B: 0.05 perm.
f. Water Absorption: ASTM D570: 0.1% (weight/72 hours).

3. Miscellaneous Materials: Primer, detail coatings, flashing, bonding adhesive, splicing cement, lap sealant, water cut-off mastic, pipe seals, pourable sealer, and other related items as recommended by membrane manufacturer.

4. Cants: At all inside corners; minimum face 3/4".

5. Miscellaneous: As required for complete installation.

6. Manufacturers
   a. Bituthene 4000 by W.R. GRACE
   b. Mel-Rol System by W.R. MEADOWS
   c. CCW MiraDri 860/861 by CARLISLE
   d. WP-200 by HENRY
   e. Polyguard 650 by POLYGUARD PRODUCTS

C. Underslab Sheet Membrane: Reinforced, composite waterproofing sheet specifically designed for pre-applied underslab waterproofing conditions.

1. Performance Properties
   d. Water Absorption – ASTM D570: 0.5% maximum.

2. Miscellaneous Materials: Primer, detail coatings, flashing, bonding adhesive, splicing cement, lap sealant, water cut-off mastic, pipe seals, pourable sealer, and other related items as recommended by manufacturer

3. Manufacturer: The following products are acceptable provided they meet the specified performance properties:
   a. Polyguard Underseal Underslab by POLYGUARD PRODUCTS
   b. Preprufe 300 Membrane by W.R. GRACE.
   c. Mel-Rol Precon Membrane by W.R. MEADOWS.
   d. Miraply H by CARLISLE CCW

D. Accessories
1. Vertical Protection Board
   a. Vertical Protection Board - At Elevator Pit Walls: Asphaltic hardboards "Protection Course" by W.R. MEADOWS or W.R. GRACE; 1/4" thick; one layer required.
   b. Vertical Protection/Drainage – All Other Locations
      1) Description: 3/8" thick high impact polystyrene drainage core with filter fabric adhered to core.
      2) Adhesive and Tape: Types as recommended by drainage board manufacturer.
      3) Manufacturer: Hydroduct HSF by W.R. GRACE; Amerdrain 650 by AMERICAN WICK DRAIN CORPORATION; CCW Miradrain 6200XL by CARLISLE; Hydrodrain by HYDROTECH; PolyFlow 15 by POLYGUARD PRODUCTS.
c. Insulation Protection Board: Rigid insulation. See Section 07 21 00. Provide in addition to drainage board at all location except elevator pit walls.

2. Horizontal Protection/Drainage Board
   a. Description: 3/8" thick high impact polystyrene drainage core with filter fabric adhered to core.
   b. Adhesive and Tape: Types as recommended by drainage board manufacturer.
   c. Manufacturer: Hydroduct HSF by W.R. GRACE; Amerdrain 650 by AMERICAN WICK DRAIN CORPORATION; CCW Miradrain 6200XL by CARLISLE; Hydrodrain by HYDROTECH; PolyFlow 18 by POLYGUARD PRODUCTS.

3. Expansion Joint Fillers: Provide membrane support and additional membrane length at joints.
   a. Above Grade: Sponge foam tubing, size and properties as recommended by waterproofing membrane manufacturer.
   b. Below Grade: Closed cell neoprene gaskets; ASTM D1056 Class SC (oil resistant, medium swell), 2 to 5 psi compression deflection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
   1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
   2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.
   3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

B. Proceed with installation only after unsatisfactory conditions are corrected.

3.02 PREPARATION OF SUBSTRATES

A. Prepare, fill, prime, and treat substrates to receive waterproofing membrane, including joints, cracks, corners and penetrations according to manufacturer's written instructions and recommendations. Remove dust and dirt from joints and cracks according to ASTM D 4258.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction. Mask termination elevations to prevent application of waterproofing materials on surfaces exposed to view.

C. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
D. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

E. Semi-Liquid Membrane: Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

F. Outside Corners: Bevel or round outside corners of substrate by grinding to produce a minimum 3/4" face or radius if not provided under Division 03 or use other means to treat outside corners approved by waterproofing manufacturer.

G. Inside Corners: Prepare and treat using methods recommended by manufacturer.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to manufacturer's written instructions and recommendations and ASTM D 6135 (for sheet membrane).

3.03 INSTALLATION - SEMI-LIQUID SYSTEM

A. General
1. Comply with manufacturer's instructions and details, except where more stringent requirements are indicated or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.
2. Terminate membranes above wearing surface as indicated and where concealed by subsequent finish materials. Where concealment is not possible, terminate slightly below wearing surface (approximately ½”).

B. Flashing
1. Install elastomeric flashing sheets at terminations of waterproofing membrane according to manufacturer's written instructions.
2. Prime substrate with surface conditioner.
3. Install elastomeric flashing sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.
4. Extend elastomeric flashing sheet up walls or parapets a minimum of 8 inches above and 6 inches onto deck to be waterproofed.
5. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of waterproofing.

C. Membrane
1. Apply surface conditioner, at manufacturer's recommended rate, over prepared substrate and allow to dry.
2. Heat and apply rubberized asphalt according to manufacturer's written instructions.
   a. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.
3. Start application with manufacturer's authorized representative present.
4. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils; embed reinforcing fabric, overlapping sheets 2 inches; spread another 125-mil-
thick layer to provide a uniform, reinforced, seamless membrane 215 mils thick.

5. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

6. Cover waterproofing with protection course with overlapped joints while membrane is still hot to ensure good bond.

3.04 INSTALLATION - SHEET MEMBRANE SYSTEM

A. General

1. Comply with manufacturer's instructions and details, except where more stringent requirements are indicated or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

2. Terminate membranes above wearing surface as indicated and where concealed by subsequent finish materials. Where concealment is not possible, terminate slightly below wearing surface (approximately ½”).

B. Comply with ASTM D6135.

C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprim areas exposed for more than 24 hours.

D. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

E. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

F. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

G. Seal edges of sheet-waterproofing terminations with mastic.

H. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

J. Immediately install protection course with butted joints over waterproofing membrane.
3.05 INSTALLATION – UNDER SLAB SHEET MEMBRANE

A. Preparation: As recommended by membrane manufacturer. Compact substrate as specified in Division 31, Earthwork. Remove loose aggregate or sharp protrusions. Fill gaps or voids greater than ½”. Remove standing water prior to membrane applications.

B. Installation: In accordance with manufacturer’s instructions.

3.06 INSTALLATION OF DRAINAGE AND PROTECTION ASSEMBLY

A. Exposed Waterproofing System: Provide protection assemblies as follows:

1. Horizontal Surfaces: After all curing, testing and repair work is complete, install protection/drainage board assembly as follows:
   a. Install drainage panels over membrane, with tight butt joints and completely covering membrane. Adhere with adhesive as recommended by panel manufacturer.
   b. Overlap fabric onto previous panel. Adhere overlapped filter fabric with tape or mastic as recommended by manufacturer.

2. Vertical Surfaces
   a. Elevator Pit Walls: After all curing and repair work is complete and prior to backfilling, install one layer of 1/4” thick protection board over membrane, placing boards with tight butt joints and completely covering membrane.
   b. All Other Walls
      1) After all curing and repair work is complete and prior to backfilling, install one layer of drainage/protection board over membrane, placing boards as recommended by manufacturer with tight butt joints and completely covering membrane.
      2) Rigid Insulation: Provide rigid insulation in addition to drainage/protection board. See Section 07 21 00.
   c. Do not nail or otherwise penetrate membrane to attach protection boards. Use suitable adhesive compatible with membrane.

3.7 FIELD QUALITY CONTROL

A. Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish daily reports to Architect.

B. Engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

C. Prepare test and inspection reports.

3.8 CLEANING, PROTECTION AND REPAIR

A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.
B. Protect installed [board insulation] [and] [insulation drainage panels] from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Horizontal Applications
1. Do not permit foot or vehicular traffic on unprotected membrane.
2. After installation of protection board, no traffic is permitted on deck except as required to install subsequent materials and then only after additional protection is provided.
3. Provide additional (temporary) protection as follows:
   b. Light Equipment: Minimum 2x planking over plywood.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION
SECTION 07 11 13
BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide bituminous dampproofing on exterior of perimeter foundation walls, turn down slabs, and concrete / masonry back-up surfaces within wall cavity from top of slab at grade down to top of footings along the subsurface perimeter that does not enclose conditioned areas of approximately 4 to 6 feet in depth.

1.02 RELATED SECTIONS

A. Waterproofing: Section 07 10 00: for all other subsurface moisture protection.
B. Air/Vapor Barriers: Section 07 27 26: for above grade envelope protection.
C. Concrete Masonry: Section 04 22 00.
D. Below Grade Foundation Walls: Structural drawings.

1.03 SUBMITTALS

A. Submit product data, manufacturer's installation instructions, manufacturer's review, guarantee, and statement of application in accordance with General Conditions and Section 01 33 23.

B. Product Data: Submit manufacturer's specifications, application instructions and general recommendations for dampproofing. Include data substantiating that materials are recommended by manufacturer for applications indicated.

C. Statement of Application: Submit statement signed by Contractor and installer, stating that work complies with these specifications and that the installation methods complied with the manufacturer's printed specifications and instructions for the conditions of installation and use on this project.

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in the manufacture of specific type of dampproofing system specified with ten years minimum experience.

B. Manufacturer's Representative (primary material manufacturer): When required, furnish services of manufacturer's technical representative at the job site to advise on dampproofing work. Install in accordance with the manufacturer's instructions, unless more stringent requirements are required; the more stringent shall govern.

C. Note: It is the intent of the drawings and this section to provide a complete continuous vapor barrier envelope at all perimeter walls and roof. At all junction
points between the two planes, lap membrane approximately 6" and seal with tape or other methods recommended by membrane manufacturers. Notify Architect of areas or situations where a continuous vapor barrier cannot be achieved.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened packaging fully identified with brand, type, grade, class and other qualifying information including instruction for use and identifying numbers.

B. Storage materials in a dry area away from high heat, flames or sparks. Provide weatherproof covering on top and all sides, allowing for adequate ventilation.

C. Store only as much material at point of use as required for each day's work.

D. Handling: Handle all materials in a manner to prevent damage of any kind. Remove damaged material from the site and replace with new specified material.

1.06 JOB CONDITIONS

A. Install dampproofing only when satisfactory conditions prevail. Verify requirements with manufacturer of specific products; variances may occur.
   1. Minimum temperature for installation to proceed is 40°F (verify) and rising.
   2. Substrate temperature between 40°F (verify) and 110°F.
   3. Surfaces to receive dampproofing shall be free of water, dew, frost, snow and ice.

B. Ventilation: Provide positive ventilation for enclosed areas continuously throughout the application and for a minimum of 8 hours afterward or until coatings have completely cured.

C. Do not expose membrane or accessories to a constant temperature in excess of 180°F.

D. Do not allow waste products (petroleum, grease, oil, solvents, vegetable or mineral oil, etc.) to come in contact with the material.

E. Special Precautions: Allow no open fires or spark-producing equipment in the application area until vapors and fumes have dissipated. Post "No Smoking" signs in area during application and maintain for at least 8 hours following application.

PART 2 PRODUCTS

2.01 BITUMINOUS DAMPPROOFING

A. Description: Cold-applied water based fiber reinforced asphalt compound, non-asbestos.

B. Reference: Conform to ASTM D1227, Type II, Class 1 and ASTM D1187, Type I.
C. Physical Properties
1. Solids by Weight: 52 to 54%
2. Solids by Volume: 49 to 51%
3. Permeance: 0.5 metric perms

D. Manufacturer: 220AF Fibrated Emulsion Dampproofing by KARNACK CORPORATION, Hydrocide 700B by BASF BUILDING SYSTEMS, Sealmastic Emulsion by W.R. MEADOWS.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate application of dampproofing with laying of concrete masonry units, rigid insulation, reinforcing and veneer work. Contractor must obtain A/E's approval to apply dampproofing when CMU and veneer work progress simultaneously.

3.02 SURFACE CONDITIONS

A. Concrete Masonry Surfaces: Flush joints; free of loose mortar chipped or broken masonry or other irregularities.

B. Verify surfaces are clean, dry and free of frost, dew, loose dirt, and foreign matter.

3.03 PROTECTION

A. Mask off or otherwise protect adjoining surfaces which are not scheduled to receive dampproofing to effectively prevent spillage or overspray of materials beyond dampproofed area.

3.04 INSTALLATION

A. Comply with manufacturer's instructions and details, except where more stringent requirements are indicated or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

B. Apply dampproofing in a manner to completely cover wall surface and seal around reinforcing.

C. Application Method: Brush or spray. Thickness: 1/16" to 1/8".

3.05 CLEAN-UP

A. Clean stains from adjacent materials. Replace materials that cannot be cleaned at no additional cost to Owner.

END OF SECTION
PART 1  GENERAL

1.01  WORK INCLUDED  typically used materials

  A. Rigid board insulation in masonry cavity walls.
  B. Insulated sheathing at masonry veneer walls.
  C. Perimeter and under slab insulation.
  D. Semi-rigid glass-fiber [wall] [ceiling] [sloped wall] insulation.
  E. Spray polyurethane foam insulation.
  F. Spray-applied cellulose insulation.
  G. Rigid board insulation at furred [masonry] [concrete] wall.
  H. Plaza deck rigid insulation.
  I. Double slab rigid insulation.
  J. Waterproofing protection board, when used as combination protection board/perimeter insulation.
  K. Glass fiber blanket wall and ceiling insulation.
  L. Glass fiber batt insulation for ceiling tile/grid application.
  M. Sound attenuation blankets in stud/gypsum board walls.
  N. Spandrel glass/curtainwall insulation.
  O. Concrete masonry unit (CMU) insulation – foamed in place.
  P. Plenum liner and tunnel liner insulation.
  Q. Semi rigid mineral wool insulation in [masonry cavity walls] [rainscreen applications].

1.02  RELATED SECTIONS

  B. Wood Nailers: Section 06 10 00.
B. Wood Nailers: Section 06 10 50.

C. Pour-in Masonry Insulation: Section 04 00 00.

D. Masonry Insulation – Foam Inserts: Section 04 00 00.

*E. Roof Insulation: Section 07 53 23.

F. Firestopping (Safing): Section 07 84 00.

1.03 SUBMITTALS

A. Product Data: Submit for all items.

B. Spray Foam Insulation Qualification Data: For qualified installer.

1.04 QUALITY ASSURANCE

A. Insulation Thermal Properties: Thermal conductivity k-factors and thermal resistance R-values indicated are values at 75 degrees F., mean temperature.

1. Where insulation is identified by R-value, provide thickness required to achieve indicated R-value. Foam insulation R-values are "aged" thermal values in accordance with LTTR – Long Term Thermal Resistance predicted by ASTM C1289.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. [Spray Foam Insulation Installers: Trained and approved by manufacturer and with experienced in performing application of SPF materials on not less than five projects with similar quantities of sprayed insulation materials in similar applications.

1. Sample: A representative surface of not less than 100 sq. ft. shall be sprayed and approved before proceeding with spray insulation work. ]

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation materials in manufacturer's original, unopened, and labeled packages.

B. Store insulation materials at the site inside storage trailers or the building in a dry, ventilated place. Exterior storage not permitted. Comply with manufacturer's recommendations for handling and protection during installation.

C. Remove fibrous batt insulation that has become wet before or after installation. Replace with new, dry insulation.

D. Protect plastic insulation from excessive exposure to sunlight. Protect at all times against ignition. Complete installation and covering of plastic insulation materials
as rapidly as possible in each area of work.

PART 2  PRODUCTS

2.01  RIGID BOARD INSULATION - POLYSTYRENE

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 25 psi, 1.6 p/cf.; maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
   1. Plaza deck and double slab areas: ASTM C578 Type III, 60 psi, 2.2 p/cf.

B. Thicknesses: Provide the following unless otherwise indicated on the drawings.
   1. Masonry Cavity Wall Application: 2 inch.
   2. Perimeter/Under Slab Application: 2 inch.
   5. Plaza Deck: As indicated.
   6. Double slabs at Garage: 4".

C. Adhesive: Types as recommended by insulation manufacturer for substrates and substrate coating materials where applicable.

D. Manufacturer: Subject to compliance with requirements, provide products by DOW CHEMICAL Styrofoam; OWEN S CORNING Foamular; KINGSPAN GreenGuard; DIVERSIFOAM PRODUCTS Certifoam

2.02  GLASS-FIBER BLANKET INSULATION

A. Type: Glass fiber blanket designed to friction fit with metal. Manufacturers standard lengths; widths as required to fit framing conditions; density not less than 0.75 pounds per cubic foot. Provide facings as follows:
   1. Unfaced: Conform to ASTM C665 Type I, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E 136 for combustion characteristics.
   2. Kraft Facing: Areas where insulation is not exposed (concealed behind gypsum board). Conform to ASTM C665 Type II, Class C, Category 1.
   3. Flame Resistant Foil Facing: Areas where insulation is exposed (not covered by gypsum board or concealed interstitial space between faced insulation and gypsum wall board face). Conform to ASTM C665 Type III, Class A, Category 1; flame-spread index of 25 or less.

B. Thickness (Nominal)
   1. Wall: 6", unless otherwise indicated.
   2. Ceiling: 10", unless otherwise indicated.

B. Thickness: As indicated.

D. Manufacturer: Subject to compliance with requirements, provide products by JOHNS MANVILLE, OWENS-CORNING FIBERGLASS, CERTAINTEED,
GUARDIAN BUILDING PRODUCTS or KNAUF INSULATION.

E. Tape: Type as approved by insulation manufacturer.

2.03 SOUND ATTENUATION BLANKETS

A. Type: Unfaced semi-rigid mineral fiber or glass fiber blankets. Conform to ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

B. Thickness: 3 inch, unless otherwise indicated.

C. Manufacturer: Subject to compliance with requirements, provide products by JOHNS MANVILLE; THERMAFIBER, OWENS-CORNING FIBERGLAS, CERTAINTEED, ROXUL or FIBREX.

2.04 SPANDREL GLASS/CURTAINWALL INSULATION

A. Manufacturer: Subject to compliance with requirements, provide products by JOHNS MANVILLE, OWENS-CORNING FIBERGLAS, CERTAINTEED, GUARDIAN BUILDING PRODUCTS or KNAUF INSULATION; fiberglass insulation with factory-applied [integral foil scrim Kraft facing] [black fiber glass mat facing].

B. Type: Unfaced, Glass-Fiber Board Insulation: ASTM C 612, Type IA; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84, passing ASTM E136 for combustion characteristics.
   1. Nominal density of 2.25 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.
   2. Thickness: As indicated on drawings.

C. Foil-Faced, Glass-Fiber Board Insulation: ASTM C612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84.
   1. Nominal density of 2.25 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.
   2. Thickness: As indicated on drawings.

D. Dark-Surfaced, Glass-Fiber Board Insulation: ASTM C612, Type IA; faced on one side with black glass-fiber mat or black polymer finish; maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84.
   1. Nominal density of 2.25 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.
   2. Thickness: As indicated on drawings.

2.06 SPRAY-APPLIED CELLULOSE INSULATION

A. Self-Supported, ASTM C 1149, [Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications)] [Type II (materials containing a dry adhesive activated by water during installation; intended only for...
enclosed or covered applications), chemically treated for flame-resistance, processing, and handling characteristics.

B. Manufacturer: K-13 Spray-On-Systems insulation manufactured by INTERNATIONAL CELLULOSE CORPORATION; materials manufactured by THERMACOUSTIC or PRO CELL are acceptable provided they meet the specified requirements.

C. Description

2. Performance Requirements
   a. Thermal Resistance: **R-16**
   b. Apply at minimum thickness to provide an R value as specified.
   c. Bond Strength (ASTM E736)
      1) Not less than 400 psf
      2) Not less than 600 times its weight @ 1"
3. Labeling: The sprayed insulation must have been tested in sprayed form by U. L. and have each bag labeled with the reference to U.L. test results according to ASTM E84/U.L. 723;
   a. Class 1
4. Fire Resistance
   a. Flame spread: 5.
   b. Smoke Development: 5.

### 2.07 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Type

1. Material: ASTM C1029, Type III, closed cell polyurethane foam insulation containing no CFC's, HCFC's and VOC's.
2. Physical Properties
   a. Density (ASTM D1622): Minimum 2.0 pcf
   b. Closed cell content (ASTM D6226): >90%
   c. Thermal Conductivity: R-Value = 6.4/inch. R-values are "aged" thermal values in accordance with PIMA Bulletin #101 and RIC/TIMA Bulletin #281-1 conditioning procedures
   f. Fire performance in accordance with ASTM E84 and UL 723 flame spread 25 or less and smoke development 450.
3. Thickness: As indicated or as required to fill voids where applicable.
   [a. Stud Cavity: As indicated]
4. Primer: Type as recommended by insulation manufacturer for adjacent and substrate surfaces. Ensure adjacent wall framing members are not deflected after installation and cure.
5. Where foam insulation is left exposed to building interior, provide approved 15 minute thermal or ignition barrier meeting the requirements of NFPA 286 and IBC Section 2603.4 (minimum ½" gypsum board, intumescent coating or similar code complying material).
a. Bonding Agent: Provide suitable agent to ensure adequate bond between spray foam insulation and thermal barrier.

6. Transition Membrane between Air Barrier Membrane and Roofing and Other Adjacent Materials: As recommended by manufacturer and comply with both air barrier manufacturer's recommendations and roofing material manufacturer's recommendations (as applicable).

7. Manufacturers: Subject to compliance with specified requirements, provide products by HENRY, DOW, JOHN MANVILLE, BASF, CERTAINTEED, GACO-WESTERN or ICYNENE.

B. Open Cell Type
1. Material: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
   a. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F.
2. Primer: Type as recommended by insulation manufacturer for adjacent and substrate surfaces.
3. Manufacturers: Subject to compliance with specified requirements, provide products by DEMILEC, GACO-WESTERN or ICYNENE.

2.08 SEMI-RIGID GLASS–FIBER INSULATION

A. Type: Semi-rigid, unfaced glass fiber boards. Conforming to ASTM C612, Type 1A and 1B.

B. Thickness: 1", unless otherwise indicated.

C. Thermal Conductivity - R-Value: 4.3 for 1".

D. Density: 3.0 pcf.

E. Surface Burning Characteristics:

1. Flame Spread 15
2. Smoke Developed 0

E. Manufacturer: Microlite by JOHNS MANVILLE; Type 703 by OWENS-CORNING; subject to compliance with requirements, products by one of the following is acceptable CERTAINTEED, GUARDIAN BUILDING PRODUCTS or KNAUF INSULATION.

2.09 INSULATED SHEATHING

A. Material: Polyisocyaurate, foil faced, conforming to ASTM C1289, Type I, Class 2, minimum density 1.9 pcf.; foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.

3. Water Absorption – ASTM C206: Maximum 0.05% by volume.
4. Water Vapor Permeance – ASTM E96: <0.03 perms.

B. Thickness: 2" [1-1/2"] [1/2"] [5/8"].

C. "R" Value: Minimum 13.0 [9.6] [3.25] [4.0]

D. Fasteners and Adhesive: Types as recommended by insulation manufacturer.

E. Manufacturer: Thermax; DOW CHEMICAL; Energy Shield by ATLAS ROOFING; Isoshield Silver by APACHE PRODUCTS; R-MAX Ecomax: Xci by HUNTER.

2.10 FOAM-IN-PLACE CONCRETE MASONRY INSULATION

A. Contractor’s Option - Exterior concrete masonry walls and concrete masonry party walls: Contractor may use one of the insulation types as specified below. The same type must be used throughout the entire project. Provide one of the following types of insulation:

1. Rigid Foam Inserts: See Section 04 00 00.
2. Foam-In-Place: As specified herein.

B. Foam-In-Place

1. Physical Properties
   a. Thermal Conductivity – ASTM C177: .066 (3-1/2" thickness @ 75°F)
   b. "R"-Value (Block and Insulation)
      1) 8" CMU (60 lb. Density block): 14.0 minimum.
      2) 12" CMU (60 lb. Density block): 20.0 minimum.
   c. Density – ASTM D1622: 0.7 pcf.
   d. Fire Safety ASTM E84
      1) Flame Spread: 25 or less.
      2) Smoke Developed: 450 or less.

2. Manufacturer: Provide one of the following:
   a. TAILORED CHEMICAL PRODUCTS Core-Fil 500
   b. C.P. CHEMICAL COMPANY Tripolymer
   c. THERMAL CORPORATION OF AMERICA Thermco
   d. JESCO, INC. Rapco Foam

2.11 PLENUM LINER AND TUNNEL LINER INSULATION

A. Description: Rigid fiberglass core with black fiberglass top layer and black spray applied polymer coating. Treat airstream surface mat facing with an EPA-registered anti-microbial agent.

1. Thickness: 2".
2. Density: 3.0 pcf.
3. R-Value: 8.7.

B. Compliance: Conform to ASTM C1071, Type II; ASTM D5116; ASTM G21 and G22 and 90A and 90B.
C. Surface Burning: Does not exceed 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, NFPA 255 and UL 723.

D. Air Velocity – ASTM C1071: Maximum 5000 fpm; tested to 12,500 fpm.

E. Water Absorption – ASTM C1104: Less than 3% by weight.

F. Manufacturer: Rigid Plenum Liner by KNAUF or equal by JOHNS MANVILLE, OWENS-CORNING FIBERGLASS, CERTAINTEED, GUARDIAN BUILDING PRODUCTS or KNAUF INSULATION.

2.12 SEMI RIGID MINERAL WOOL INSULATION

A. Manufacturer: Subject to compliance with requirements, provide products by THERMAFIBER, ROXUL or FIBREX INSULATIONS INC.

B. Unfaced: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Thickness: As indicated.
2. R-value: 4.2 per inch.
5. Fiber Color: Darkened color [at rainscreen applications] [where indicated].

C. Foil-Faced: ASTM C 612; faced on one side with foil-scim or foil-scim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 25 and 5, respectively, per ASTM E84.

1. Thickness: As indicated.
2. R-value: 4.2 per inch.
5. Fiber Color: Darkened color [at rainscreen applications] [where indicated].

D. Hardware: Clip as recommended by manufacturer compatible with types of wall systems.

2.13 ACCESSORY MATERIALS

A. Supplementary Support: Provide galvanized wire mesh, woven wire ties or flexible metal rods where required for supplementary support of insulation in permanent proper location.

B. Insulation Clips

1. Description: Perforated metal plates (2" x 2") with metal spindle welded and extending through center. Speed washer (1" x 1") snaps over spindle to secure insulation.
2. Adhesive: Type as recommended by clip manufacturer for adhesion to the
PART 2

3. Spacing: As recommended by manufacturer.
4. Spindle Length: As selected to ensure tight fit without compressing insulation so as to decrease insulation value.
5. Manufacturer: AGM INDUSTRIES, INC. Series T TACTOO Insul-Hangers; ECKEL INDUSTRIES OF CANADA; Stic-Klip Type N Fasteners; GEMCO; Spindle Type.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

PART 3 EXECUTION

3.01 PREPARATION

A. Examine substrates and installation conditions. Do not proceed with insulation work until unsatisfactory conditions have been corrected.

B. Verify substrate surfaces are dry and free of irregularities or substances harmful to insulation. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

C. Verify mechanical and electrical services within walls have been installed and tested.

D. Fill miscellaneous voids and spaces in wall framing and at window and door framing with batt insulation loosely stuffed in place.

E. Spray-On and Spray Foam Insulations: Provide masking, drop cloths or other satisfactory coverings for all materials/ surfaces which are not to receive insulation to prevent damage from overspray.

3.02 INSTALLATION OF RIGID BOARD [SEMI-RIGID] INSULATION - CAVITY WALL

A. Place insulation horizontally within cavity between brick and concrete block. Place on exterior surface of concrete block.

B. Place to ensure tight joints between all insulation panels installed.

C. Use manufacturer's suggested adhesive to bond the insulation panel to the concrete block wall.

D. Place insulation panels to clear wall ties, yet maintain a tight joint between the panels.

3.03 INSTALLATION OF RIGID BOARD INSULATION - PERIMETER INSULATION

A. Place at all slab-on-grade conditions at building perimeter.
B. Adhere to substrate as required to maintain insulation in final location prior to backfilling.

C. Coordinate placement of insulation with placement of vapor barrier. See Section 07 26 00.

3.04 INSTALLATION OF RIGID BOARD - WATERPROOFING PROTECTION BOARD

A. Coordinate installation of insulation (waterproofing protection board) with application of waterproofing. See Section 07 10 00.

B. Place insulation boards with long edge horizontally on exterior waterproofed walls below grade.

3.05 INSTALLATION OF RIGID BOARD INSULATION - FURRED MASONRY AND CONCRETE WALLS

A. Place insulation between furring members; maintain tight joints between insulation panels and between insulation panels and furring members.

B. If required, use insulation manufacturer's suggested adhesive to bond the insulation panel to the wall.

C. See Section 09 21 16 for furring members.

3.06 INSTALLATION OF BLANKET/BATT INSULATION

A. Install blanket type insulation with tight fitting butt joints. Provide supplementary support at vertical and horizontal installations when required to maintain insulation in permanent proper location.

1. Spot adhere insulation to inside face of exterior sheathing or similar back-up material as required to maintain insulation in its proper location.

B. Fit insulation between members.

C. Locate facing to room side, where applicable.

D. Install interior wall sound attenuation at interior partitions where indicated on floor plans or wall types.

3.07 INSTALLATION SPANDREL GLASS/CURTAINWALL INSULATION

A. In Curtainwall Frames at Spandrel Glass

1. Install insulation board behind spandrel glass with [foil-face away from glass] [black facing toward glass]. Leave 2" space between glass and insulation, unless otherwise detailed.

2. Screw-attach aluminum clip angles to storefront frames at 16” on centers.

3. Friction-fit the insulation between curtainwall frames against the clip-angles.

4. After insulation is properly fitted, apply a continuous piece of foil-scrim tape
against insulation board and storefront frame.
5. Apply continuous tape over spliced joints in insulation (if any).

B. Coordinate with placement of perimeter fire safing. See Section 07 84 00.

3.08 INSTALLATION OF SEMI-RIGID GLASS-FIBER INSULATION

A. Install to [underside of slab] [wall surface] [where indicated] [in the following locations:]

B. Use insulation clips and supplementary supports as required.

1. Locate and space clips as recommended by insulation manufacturer.
2. Adhere clips to substrate using adhesive of type recommended by adhesive manufacturer for substrates encountered.
3. Impale insulation over clip spindle and secure with washers.

3.09 INSTALLATION OF INSULATED SHEATHING

A. Secure insulation to exterior of metal studs. Keep perimeter fasteners 3/8” from edges and ends of boards. Fit boards tightly together and around penetrations.

B. Use type of fasteners and space fasteners as recommended by insulation board manufacturer.

3.10 SPRAY-ON CELLULOSE

A. Inspect surfaces to receive spray insulation prior to application to determine if priming/sealing is required to insure bonding and/or to prevent discoloration caused by migratory stains. Prime accordingly.

B. Installed thickness will be determined as the minimum thickness measured as per ASTM E605 field test procedure.

C. Installation, clean-up and curing: Coordinate with other trades whose work may be affected or have an effect on the insulation installation.

D. Installation, clean-up and curing: According to manufacturer’s recommendations.

E. Provide natural or mechanical ventilation continuously to properly cure the insulation.

3.11 PLENUM AND TUNNEL INSULATION

A. Install on face of concrete or CMU surfaces.

B. Conform to manufacturer’s installation instructions.

C. Use insulation clips and adhesive as required.

1. Locate and space clips as recommended by insulation manufacturer.
2. Adhere clips to substrate using adhesive of type recommended by adhesive manufacturer for substrates encountered.
3. Impale insulation over clip spindle and secure with washers.
4. Paint all mechanical fasteners black to match insulation board.

3.07 SPRAY FOAM INSULATION

A. Prepare surfaces as recommended by insulation manufacturer. Remove substances from metal deck or other metal surfaces that will prohibit insulation/metal bond. Apply primer where required by manufacturer.

B. Spray-Applied Insulation: Install Spray-application of polyurethane foam in accordance with ULC S705.2 and the manufacturer’s instructions. Install in areas where indicated on the drawings. Fill all voids for a complete solid installation.

C. Trim, as needed, any excess thickness that would interfere with the application of cladding/covering system by other trades.

D. Clean-up all overspray from adjacent surfaces and floor.

END OF SECTION
SECTION 07 27 26
FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
1. Type 1 - Fluid-applied vapor retarding air barrier on CMU and concrete.
2. Type 2 - Fluid applied vapor permeable air barrier on sheathing.

1.02 RELATED SECTIONS

A. Gypsum Board Assemblies for wall sheathings and wall sheathing joint-and-penetration treatments: Section 09 21 16.
B. Building Insulation for foam-plastic board insulation: Section 07 21 00.
C. Joint Sealants for joint-sealant materials and installation: Section 07 92 00.
D. Through-Wall Flashing Membrane: Section 04 22 00.

1.03 DEFINITIONS

A. ABAA: Air Barrier Association of America.
B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 PRECONSTRUCTION TESTING

A. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
1. Contractor will engage a qualified testing agency.
2. Qualitative Testing: Mockups will be tested for evidence of air leakage according to ASTM E1186, smoke pencil with pressurization or depressurization.
3. Quantitative Air Leakage Testing: Testing of the mockup for air leakage will be conducted not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage when tested according to ASTM E283.
4. Notify Architect seven days in advance of the dates and times when mockup testing will take place.

1.05 REFERENCES

A. The following standards are applicable to this section:
3. ASTM E1677 Specification for Air Retarder (AR) Material or System for Low-Rise Framed Building Walls

1.06 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction. Include details of interfaces with other materials that form part of air barrier. Include details of mockups.

C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

D. Qualification Data: For Applicator.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.07 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Mockups: Before beginning installation of air barrier, apply air barrier to masonry mock-up constructed under section 04 22 00, build mockups cold-formed metal framing and sheathing construction indicated and apply air barrier to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
   1. Coordinate construction of mockup to permit inspection by testing agency of air barrier before external insulation and cladding is installed.
   2. Include junction with foundation wall intersection.
   3. If Architect determines air barrier applications to mockups do not comply with requirements, reapply air barrier until approved.
C. Pre-installation Conference: Conduct conference at Project site.
   1. Include installers of other construction connecting to air barrier, including roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
   2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply barrier to a damp or wet substrate or during snow, rain, fog or mist.

1.10 WARRANTY

A. Submit manufacturer's 10 year material warranty.

PART 2 PRODUCTS

2.01 FLUID-APPLIED MEMBRANE AIR BARRIER – TYPE 1

A. Class 1 Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Cold-applied, elastomeric membrane.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Elastomeric Modified Bituminous Membrane:
         1) HENRY COMPANY; Air-Bloc 06.
         2) CARLISLE COATINGS & WATERPROOFING; Barriseal.
         3) MEADOWS, W. R., INC.; Air-Shield LM.
         4) STO CORPORATION; Sto Guard Vapor Seal.
      b. Composite Rubber Membrane:
         1) RUBBER POLYMER CORP. Rub-R-Wall Airtight.
         2) BASF Enershield – I
         3) MOMENTIVE – GE SEC2600 SilShield AWB
2. Physical and Performance Properties
   a. Air Permeability ASTM E2178: 0.004 cfm / ft² @ 1.57 lbs / ft² and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft² for 1 hour and gust wind load pressure of 62.8 lbs/ft² for 10 seconds when tested at 1.6 lbs/ft² to ASTM E331
   b. Water vapor permeance: 0.09 perms to ASTM E96
   c. Wet Film Thickness: Per manufacturer as required to achieve performance and code compliance.
   d. Surface Burning: ASTM E 84 Class A flame spread and smoke developed.

B. Self-adhering transition membrane: SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film. Membrane shall have the following physical properties:
1. Air leakage: <0.0001 CFM/ft² @1.6 lbs/ft² to ASTM E283
2. Vapor permeance: 0.05 perms to ASTM E96
3. Membrane Thickness: 0.0394” (40 mils)
4. Low temperature flexibility: -22 degrees F to CGSB 37-GP-56M
5. Elongation: 200% to ASTM D412-modified

2.02 FLUID-APPLIED MEMBRANE VAPOR/AIR BARRIER – TYPE 2

A. Fluid-Applied, Vapor Permeable Membrane Air Barrier: Cold-applied, elastomeric membrane.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Elastomeric Modified Bituminous Membrane:
      1) HENRY COMPANY; Air-Bloc 31.
      2) CARLISLE COATINGS & WATERPROOFING; Barritech VP.
      3) MEADOWS, W. R., INC.; Air-Shield LMP.
      4) STO CORPORATION; Emerald Coat.
      5) Momentive – GE SEC2600 SilShield AWB
   b. Silicone or Rubber or Acrylic Membrane:
      1) RUBBER POLYMER CORP. Airtight VP.
      2) BASF Enershield – HP
      3) DOW Defend Air 200

2. Physical and Performance Properties
   a. Air Permeability ASTM E2178: 0.004 cfm / ft² @ 1.57 lbs / ft² and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft² for 1 hour and gust wind load pressure of 62.8 lbs/ft² for 10 seconds when tested at 1.6 lbs/ft² to ASTM E331
   b. Water vapor permeance: 14 perms to ASTM E96 Method B
   c. Wet Film Thickness: Per manufacturer as required to achieve performance and code compliance.
   d. Surface Burning: ASTM E 84 Class A flame spread and smoke developed.

B. Self-adhering transition membrane: Vapor permeable air barrier membrane consisting of a microporous film laminate, backed with adhesive, which allows water vapor to permeate through while acting as a barrier to air and rain water. Membrane shall have the following physical properties:
1. Air leakage: <0.002 CFM/ft² @ 1.6 lbs/ft² to ASTM E283
2. Membrane Thickness: 17 mils
3. Low temperature flexibility -40 degrees F: Pass to ASTM D3111

2.03 AUXILIARY MATERIALS

A. Primer and block filler: Liquid waterborne or solvent-borne primer recommended for substrate by manufacturer of air barrier material.

B. Thru-Wall Flashing and Transition Membrane (Self-Adhering): SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film. Specified in Section 04 00 00.

C. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.

D. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

E. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

F. Stainless-Steel Sheet: ASTM A240, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

G. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft density; flame spread index of 25 or less according to ASTM E162; with primer and non-corrosive substrate cleaner recommended by foam sealant manufacturer.

H. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

I. Joint Sealant: ASTM C920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07 92 00.

J. Other materials as recommended by barrier manufacturer for a complete air and water tight barrier.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions are corrected

3.02 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for barrier application.
B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.
E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.03 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D4258 before coating surfaces.
   1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.
B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.04 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
   1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with
roofing membrane.

2. Install transition strip so that a minimum of 3 inches of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
   1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed for required bond with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts and doors. Apply manufacturer’s recommended transition strip so a minimum of 3” of coverage is achieved over both substrates. Maintain 3” of full contact over firm bearing to perimeter frames with minimum of 1” full contact
   1. Transition Strip: Roll firmly to enhance adhesion.
   2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6” o.c. Apply lap sealant over exposed edges and cavity side of flashing sheet.
   3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings, specified in Section 04 00 00, to air barrier with an additional 6-inch-wide, strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.05 AIR BARRIER MEMBRANE INSTALLATION
A. Apply air barrier membrane to form a seal with strips and transition strips to achieve a continuous air barrier according to manufacturer’s written instructions.

B. Apply air barrier membrane within manufacturer’s recommended application temperature ranges.

C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
   1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
   1. Membrane Air Barrier: 40-mil dry film thickness or greater thickness as required to meet specified performance properties.

E. Apply strip and transition strip a minimum of 1 inch onto cured air membrane according to air barrier manufacturer’s written instructions.

F. Do not cover air barrier until it has been tested and inspected by testing agency

G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Continuous structural support of air barrier system has been provided.
   3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
   4. Site conditions for application temperature and dryness of substrates have been maintained.
   5. Maximum exposure time of materials to UV deterioration has not been exceeded.
   6. Surfaces have been primed, if applicable.
   7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
   8. Termination mastic has been applied on cut edges.
   9. Strips and transition strips have been firmly adhered to substrate.
   10. Compatible materials have been used.
   11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.

13. All penetrations have been sealed.

C. Tests: Testing to be performed will be determined by the Owner's testing agency from among the following tests:
   1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, smoke pencil with pressurization or depressurization.
   2. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to ASTM E283.

D. Remove and replace deficient air barrier components and retest as specified above.

E. Special Inspections: Arrange for and facilitate special inspection in accordance with IBC Chapter 17.

3.07 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 60 days or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
   2. Protect air barrier from contact with incompatible materials and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION
SECTION 07 50 36
TOTAL ROOFING SYSTEM WARRANTY
State of Tennessee

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<tr>
<th>SBC Project Number</th>
<th>Warranty Period (Years)</th>
<th>Warranty Number</th>
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<th>Roofing System Manufacturer (&quot;Manufacturer&quot;) and address</th>
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<tr>
<th>Roofing System Manufacturer Contact</th>
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| Manufacturer Authorized Roofing Applicator ("Roofing Contractor") | and address |
|------------------------------------------------------------------|

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<tr>
<th>Designer</th>
<th>General Contractor (if different from applicator above)</th>
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The Roofing System Manufacturer, (Manufacturer) warrants to the Tennessee Board of Regents (Owner) of the above building, that subject to the Terms, Conditions, and Limitations stated in this no dollar limit (NDL) warranty, the Manufacturer will repair any leak in the Total Roofing System installed by a Manufacturer authorized roofing applicator (Roofing Contractor) for a period stated above commencing with the date of Substantial Completion. The Manufacturer will repair or replace system defects or failures.

THE TOTAL ROOFING SYSTEM COMPONENTS are defined as the following; all materials as manufactured or authorized by the Manufacturer: including, but not limited to: membrane, flashings, counterflashings, adhesives and sealants, insulation, cover boards, fasteners, fastener plates, fastening bars, metal work, insulation adhesives, and any other products utilized in this installation. (Strike out materials not included in this system and add other materials included as required):

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<th>Roofing Contractor</th>
<th>Authorized Signature</th>
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THE ROOFING CONTRACTOR CERTIFIES that the Total Roofing System was installed in strict accordance with the Manufacturer’s recommendations utilizing only the Manufacturer’s authorized products to install the Total Roofing System and that all products were protected while in their possession prior to installation and had no moisture or water trapped in the Total Roofing System. The Roofing Contractor certifies that all necessary steps were taken to ensure that all conditions were met for the issuance of The Total Roofing System Warranty by the Manufacturer.

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THE MANUFACTURER WARRANTS that if it cannot supply a specified product for inclusion in a Total Roofing System Warranty, the Roofing Contractor must obtain prior written approval from the Manufacturer for all products not supplied by the Manufacturer to be incorporated in the Total Roofing System Warranty. The Manufacturer will issue a Total Roofing System Warranty. In addition to a final inspection of the completed installation by the Manufacturer, the Manufacturer is also entitled to supplement their final field inspection with the Roofing Contractors above certification. There will be NO exceptions or exclusions to the Total Roofing System Warranty based upon products used or installation issues by the authorized Roofing Contractor, provided all materials installed are provided or authorized by the Roofing System Manufacturer.

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Total Roofing System Warranty
07 50 36 - 1
**ROOFING SYSTEM INFORMATION**

- **New Roof**
- **Reroof**

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<th>Date of Substantial Completion</th>
<th>Date of Warranty Expiration</th>
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**TOTAL ROOFING SYSTEM COMPONENTS** – list all that apply:

- Type of Roof deck(s)
- Type of metal flashing / trim / coping, etc.
- Type of vapor barrier
- Type of air barrier
- Type and thickness of flat insulation
- Type and slope of tapered insulation
- Type of recovery board
- Type of flashing

- Membrane type and color

**MANUFACTURER’S MEMBRANE INFORMATION**

List manufacturer’s roll identification for ALL rolls of used: If additional space is needed, attach additional sheet

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

**MANUFACTURER FINAL INSPECTION** performed by:

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Designated Representative present for Final Inspection:

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Owner Representative present for Final Inspection: (when practical)

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1. Owner shall provide the Manufacturer with written notice within thirty (30) days of the discovery of any leak(s) in the roof system.

2. The Manufacturer shall within fourteen (14) calendar days, commencing with receipt of written notice from the Owner, inspect the roofing system in the presence of the Owner’s representative (when practical) and if the cause(s) of the leak(s) is found the responsibility of the Manufacturer under this warranty, promptly make or cause to be made, the repair(s) or replacements(s) necessary to return the roofing system to the condition which is watertight and remediate moisture. All repair expenses incurred in connection herewith will be the responsibility of and borne by the Manufacturer.

3. If upon joint inspection by the Manufacturer and the Owner’s representative of the roofing system as provided in Paragraph 2, the cause(s) of any leak(s) is found not the responsibility of the Manufacturer under this warranty, the Manufacturer will immediately advise the Owner of the type and extent of repair(s) required to be made at the Owner's expense and if such repair(s) be promptly and reasonably made by the Manufacturer, this warranty will remain in effect for the unexpired portion of the warranty period; otherwise, this warranty will become null and void with respect to the area(s) or item(s) affected.

4. In the event the Manufacturer and Owner disagree as to the cause(s) and responsibility of the leak(s), then the Owner, without prejudice to any other remedy Owner may have, may make repair(s) of any leak(s) in accordance with Manufacturer recommendations if timely made available. Such action by the Owner shall not constitute a violation of this warranty. The Owner reserves the right to pursue reimbursement from the Manufacturer for all cost(s) and expense(s) of such repair(s), subject to the Manufacturer's responsibility under this warranty. If it is determined that the Manufacturer has no responsibility for the leak(s) under this warranty, the Owner will reimburse the Manufacturer for direct expenses encountered for trips requested by the Owner after the initial inspection.

5. In the event an emergency condition arises where, in the reasonable opinion of the Owner immediate reasonable repair(s) are necessary to avoid substantial damage to the building or its contents and the Manufacturer advises the Owner in writing of its inability, for reasons beyond its control, to inspect and repair the roof system as necessary within fourteen (14) days of written notification from the Owner, then the Owner may make such temporary repair(s) as in the opinion of the Owner are essential and necessary and such action by the Owner shall not constitute a violation of this warranty. In these circumstances, the Manufacturer shall reimburse the Owner for all reasonable costs and expenses of such temporary repair(s) subject to the Manufacturer's responsibility under this warranty.

6. In the event the Manufacturer fails to respond to written notification of known or suspected leak(s) as provided in Paragraph 2, the Owner may, after fourteen (14) days following receipt by the Manufacturer of an additional written notice and without prejudice to any other remedy he may have, make permanent repair(s) of any leak(s) and recover all reasonable costs and expenses of such repair(s) from the Manufacturer. The Manufacturer will, upon demand by the Owner, promptly reimburse the Owner these reasonable repair costs and expenses. Such action by the Owner shall in no way negate the responsibilities of the Manufacturer under this warranty for the unexpired portion of the warranty period.

7. Except as provided in Paragraphs 4, 5 & 6, any alterations of the roofing system after completion and acceptance including the placement of fixtures, utilities and equipment on or through the roof or additions thereto, will render this warranty null and void with respect to the area(s) or item(s) affected unless prior written authorization of such alterations of the roof system or additions thereto is given by the Manufacturer. Such authorization will not be unreasonably withheld.

8. This warranty shall not be applicable to the extent the roofing system sustains damage(s) by any of the following:
   (a) Acts of God and natural disasters, including but not limited to lightning, hurricanes, tornadoes, and earthquakes, winds of (3 second) peak gust speeds of 72 MPH or higher (determined by the nearest US Weather Station measured at 10 meters above ground or at the given address if reliable pinpoint wind data is available for the address), hail with a diameter greater than two inches;
   (b) Acts of negligence (whether of omission or commission), fire, accidents, or misuse, including but not limited to vandalism, civil disobedience, or acts of war, provided same are not caused by the Manufacturer and/or the Contractor.
   (c) Failure by the Owner to use reasonable care in maintaining the roof and appurtenances, provided same caused the leak(s) or item(s) affected; or,
   (d) For built-up and modified bitumen roofs: A roof design or specification authorized by the Owner with less than 1/8" per foot slope for drainage.
   (e) Building design issues that affect the performance of the Total Roofing System.

9. When the roof system has been damaged by any of the foregoing causes, repair(s) shall be at the Owner's expense and such repair(s) shall be made as provided in Paragraph 3; otherwise, this warranty will become null and void with respect to the area(s) or item(s) affected.
10. Until such time as the third year of this warranty has expired, the Manufacturer's obligations hereunder shall be joint and several with the Contractor. For the purpose of this paragraph, all of the Contractor's actions, whether of omission or commission, that are subject to this warranty are likewise the actions of the Manufacturer hereunder and shall in no way negate or reduce the responsibilities of the Manufacturer under this warranty.

11. As part of the repair of leaks, the Manufacturer shall replace roof insulation included in the this warranty that become damaged as a result of a roof leak, provided the roof leak is not excluded under the Terms, Conditions, and Limitations set forth in this warranty. The replacement of damaged roof insulation shall be limited to those boards that have lost the structural integrity necessary to support and restrain the System when it is subjected to dynamic loads such as typical roof service traffic, winds up to 72 mph, hail up to two inches in diameter, and periodic accumulations of water, snow, or ice. In the event that roof insulation is damaged as a result of a roof leak excluded under the Terms, Conditions and Limitations set forth in this warranty, the Manufacturer will advise the Owner of the type and extent of insulation and recovery board replacement to be made at the Owner's expense. Failure by the Owner to properly make these repairs in a reasonable manner using a Manufacturer licensed applicator and within a reasonable period of time shall render this Warranty null and void in the area of the damage. Neither the Manufacturer nor the Owner shall have any obligation to replace roof insulation and recovery board if the area affected by the leak is less than fifty (50) square feet.

12. The Manufacturer certifies that it:
   (a) Manufacturers or purchases products for the purpose of designing, developing, and marketing a roof system;
   (b) Provides recommendations, specifications, and details for the roofing system materials and installation;
   (c) Trains and authorizes Roofing Contractors;
   (d) Provides technical assistance to Roofing Contractors;
   (e) Approves or prepares shop drawings; and,
   (f) Provides a technical representative employed by the Manufacturer for the final inspection, and to all inspections required by this warranty.

13. During the period of this warranty, the Manufacturer, its agents or employees, will have free access to the roof during regular business hours of the Owner.

14. Owner shall be responsible for the costs associated with the removal and replacement, as well as any damage caused by the removal and replacement of any overburden, super strata, or overlays, either permanent or temporary, excluding accepted stone ballast or pavers, as necessary to expose the system for inspection and/or repair.

15. Alterations or repairs to the System that are not completed in accordance with Manufacturer's published specifications, not completed by an authorized contractor, and/or where current notification procedures were not followed are excluded and this warranty will become null and void with respect to the area(s) or item(s) affected.

16. For a 30 year single ply membrane roof system, the Total Roofing System Warranty shall cover the proper repair of leaks caused by unintentional, accidental and occasional puncture damage to the membrane as a result of normal rooftop inspection, maintenance or service; however, it does not cover damage caused by snow removal or damage caused by other trades during construction. There shall be no man hour limitation per year on accidental puncture repairs covered by this provision of the warranty. Resulting wet insulation shall be treated as set forth in Paragraph 11 above.

TOTAL ROOFING SYSTEM MANUFACTURER

Roofing System Manufacturer name

Authorized Signature & Date

Print or Type Name & Title
SECTION 07 53 23

ELASTOMERIC MEMBRANE ROOFING - EPDM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide an elastomeric sheet roofing system as shown / specified. Work includes:
1. Adhered, smooth surface elastomeric sheet roofing system.
2. Insulation.
3. Cover board.
4. Flashing, pipe seals, and roofing accessories.
5. Installing roof flashings and sheet metal furnished under Section 07 62 00.
6. Membrane flashing under metal copings.

1.02 RELATED SECTIONS

A. Rough Carpentry: Section 06 10 00.
B. Flashing and sheet metal: Section 07 62 00.
C. Roof Drains, Vents and Curbs: Divisions 22 and 23.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: To participate as a qualified company in production of Elasto/Plastic materials, the company must have a minimum of ten (10) years as the sole manufacturer of the brand name. Manufacturer shall also furnish notarized certification that he has been in business and had roofs installed for a minimum of ten (10) years.

B. Installer Qualifications: An experienced roofing installer approved or licensed by roofing materials manufacturer and with not less than ten (10) years of successful experience installing elastomeric sheet roofing systems similar to those required for this project.
1. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress. Maintain proper supervision of workmen.

C. Manufacturer's representative shall conduct timely inspection of the roof installation to satisfy all warranty requirements.

D. Factory Mutual (FM) Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
1. Fire/Windstorm Classification: Class 1A-75.
2. Hail Resistance: MH.
E. Exterior Fire-Test Exposure: ASTM E108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

F. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Owner reserves the right to cut test panels from the finished roof in order to determine that minimum requirements have been met.
1. Roof Installer: Repair, at no additional cost to the Owner, the roof where test panels were taken.

H. Insulation Thermal Properties: Thermal conductivity k-factors and thermal resistance R-values indicated are values at 75 degrees F., mean temperature.
1. Where insulation is identified by R-value, provide thickness required to achieve indicated R-value. Foam insulation R-values are "aged" thermal values in accordance with LTTR – Long Term Thermal Resistance predicted by ASTM C1289-13.

1.04 SUBMITTALS

A. Shop Drawings: Submit for all items. Include as a minimum the following:
1. Layout of roof showing sheet sizes and field joint and fastener locations.
2. Location and type of penetrations.
3. Layout of mechanical fasteners, including perimeter requirements.
4. Perimeter, penetration and special details.
5. Description of all materials.
6. Conformance to fire classifications requirements of IBC 1505.
7. Setting plans for tapered insulation.

B. Manufacturer's Approval: Obtain manufacturer's written approval of final shop drawings prior to beginning roofing operations.

C. Samples: Submit samples of all roofing and flashing materials, walkways and fasteners; 12” square samples of membrane indicating color and thickness.

D. Submit certification from roofing manufacturer that:
1. Roofing membrane and the selected roofing insulation are compatible.
2. Specifications and drawing details are acceptable for the deck and surfacing materials to which materials are to be applied.
3. Installer is trained and approved for this type of installation.
4. Roof system is adhered properly to meet or exceed the requirements of the specified FM requirements.

E. Submit specimen copy of manufacturer's roofing warranty.

G. Submit field quality-control reports.
H. Contamination Profile: Manufacturer shall provide applicator and building Owner with a tabular profile of chemicals, solutions, oils, compounds or materials which are injurious to the sheet membrane. Establish profile on a trade name or generic basis, include those materials normally found to exist in the roof environment or likely to occur on this roof.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged, labeled bundles or containers.

B. Store roofing materials, insulation and accessories at the site in storage trailers or the building in a dry, well-ventilated, weather tight place. Exterior storage not permitted. Comply with manufacturer's recommendations for handling and protection during installation.
   1. Handle rolled goods to prevent damage to edge or ends.
   2. Do not apply roofing materials to damp, frozen, dirty or dusty substrate surfaces.

C. Protection
   1. Protect adjacent materials and surfaces from damage and soiling during roofing system installation.
   2. Provide special protection or avoid heavy traffic on completed roofing work.
   3. Protect paving and structure walls adjacent to hoists before starting work.
   4. Do not overload the building structure with storage of materials or installation equipment on the substrate decking.
   5. Handle and store materials and equipment to avoid damage to substrate decking.

1.06 PROJECT CONDITIONS

A. Environmental Conditions: Install roofing only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.07 WARRANTY

A. Contractor and roofing subcontractor shall warrant the total roofing system (membrane, insulation and flashing) with respect to workmanship and proper application for two (2) years from the date of acceptance by the Owner. Should any leaks covered under the warranty occur during this period, corrective action will be taken by the Contractor to repair the roof to the satisfaction of the owner and membrane manufacturer. ALL CORRECTIVE WORK WILL BE DONE AT NO COST TO THE OWNER.

B. The manufacturer(s) of the materials used shall provide a written twenty (20) year guarantee on the complete roof installation. Upon warranty inspection and acceptance of the roof, the guaranty will be turned over to the Owner on behalf of the Contractor, by an authorized representative of the manufacturer. The guaranty shall begin when the project is completed and accepted by the Owner. Submit final guaranty in triplicate.
1. Warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories and other components of membrane roofing system.

2. System shall be warranted for all requirements specified herein, including for wind uplift as required.

C. Corrective measures on leaks shall be undertaken within seventy-two (72) hours after notification has been received by the Contractor or membrane manufacturer from the Owner.

D. If manufacturer, Contractor or roofing installer has any variance with these specifications in order to comply with required guarantees, submit same in writing to the Architect within 10 days prior to bid.

**PART 2 PRODUCTS**

2.01 MEMBRANE ROOFING

A. Manufacturers: CARLISLE SYNTES SYSTEMS; JOHNS MANVILLE, FIRESTONE and GENFLEX.

B. Membrane Materials and Components


2. Elastomeric Sheet Membrane: EPDM (ethylene propylene diene monomers) formed into uniform flexible sheets, not less than 60 mils (.060") thick.

3. Flashing: 60 mil (.060") thick EPDM sheet flashing of required shapes and sizes to suit conditions. Provide cured or uncured applicable for conditions.

C. Auxiliary Roofing Materials: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

1. General

   a. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

   b. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

      1) Plastic Foam Adhesives: 50 g/L.
      2) Gypsum Board and Panel Adhesives: 50 g/L.
      3) Multipurpose Construction Adhesives: 70 g/L.
      4) Fiberglass Adhesives: 80 g/L.
      5) Single-Ply Roof Membrane Adhesives: 250 g/L.
      6) Single-Ply Roof Membrane Sealants: 450 g/L.
      7) Non-membrane Roof Sealants: 300 g/L.
      8) Sealant Primers for Nonporous Substrates: 250 g/L.
      9) Sealant Primers for Porous Substrates: 775 g/L.
      10) Other Adhesives and Sealants: 250 g/L.
2. Bonding Adhesive: Type recommended by sheet material manufacturer for membrane, substrate and project conditions indicated.

3. Splice Adhesive: Type recommended by sheet material manufacturer for membrane, substrate and project conditions indicated. Compatible with materials with which used.

5. Splice Wash, Lap Sealant, Pourable Sealer, Water-Block Sealer, Fastener Sealer and Night Sealer: Sheet material manufacturer's recommended materials for waterproof sealing of seams in membrane and waterproof sealing of joints between flashings and roofing membrane, adjoining surfaces, projections and penetrations through the roofing membrane. Compatible with materials with which used.

6. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

7. Prefabricated Pipe Seals: Manufacturer's standard type.

2.02 INSULATION

   1. Tapered Insulation: 1/4" per foot. No slope under ¼" per foot permitted.
   2. R-Value: Provide thickness for average R of 25 over entire roof area.
   3. Minimum Thickness at Drain: 2".

B. Coverboard: Provide one of the following:
   1. ½" glass-mat, water-resistant gypsum substrate, primed surface; ASTM C1177, (adhered in adhesive). Dens-Deck by GEORGIA-PACIFIC, Secure Rock Roof Deck by USG, GlasRoc Roof Board by CERTAINTEED (adhered in adhesive)

C. Provide adhesives as recommended by insulation manufacturer for substrates encountered.

D. Mechanical fasteners for attachment of insulation to decking shall be approved by the insulation manufacturer for the system specified.
   1. The same brand fastener is to be used throughout the roof system.
   2. Number of fasteners and layout will be as recommended by the manufacturer and as per FM Approval Guide for the specified wind uplift.
   3. Length of fastener shall be determined by the thickness of the decking and any fill, and will vary in thickness of the insulation. Fasteners shall be of length to achieve a minimum of 1-inch penetration. Mechanical fasteners for attachment of Insulation NOTE: All subsequent layers of Insulation and Underlayment are to be adhered in adhesive.

E. Crickets (Tapered Insulation): Provide tapered insulation crickets sloped approximately ½” per foot. Locate and arrange as indicated on drawings or as required to divert water at rooftop equipment or vertical obstructions.
   1. Material: Polyisocyanurate; conform to requirements and manufacturers specified herein.

2.03 MISCELLANEOUS ITEMS
A. Wood Members: Comply with requirements of wood blocking, Section 06 10 00, for wood members indicated as roofing system work. Provide wood pressure treated as specified.

B. Sheet Metal and Flashings: Furnished under Section 07 62 00.

C. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, minimum ¼” thick, and acceptable to membrane roofing system manufacturer.

2.04 FASTENERS

A. Provide roofing membrane manufacturer's recommended type mechanical fastener for metal deck. Type, size and spacing shall be as required to maintain specified system warranty.

PART 3 EXECUTION

3.01 INSPECTION

A. Pre-Installation Conference: Not less than two weeks before start of roofing installation, meet at project site with Architect, Contractor, roofing installer, roofing material manufacturer's representative and mechanical and electrical trades. Review project requirements, required submittals, status of substrate work, areas of potential conflict and interference, availability of materials, installer's personnel, equipment and facilities, construction schedule, weather and forecasted weather conditions, and coordinate methods, procedures and sequencing requirements for proper installation, integration and protection of the work.

B. Examine substrates and installation conditions. Do not proceed with insulation and roofing work until unsatisfactory conditions have been corrected.

C. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 PREPARATION

A. Verify that work which penetrates roof deck, or requires men or equipment to traverse roof deck, has been completed.

B. Examine substrate surfaces for adequate anchorage, foreign materials, moisture and unevenness that would prevent the execution of roofing system specified.

C. Correct unsatisfactory conditions before starting roofing. Roof deck surface conditions shall comply with manufacturer's requirements and be acceptable to the roofing system installer.

D. Protect other work from spillage of roofing materials. Repair or replace other work damaged by installation of the elastomeric membrane roofing system work.
3.03 INSTALLATION

A. Insulation: Install insulation in accordance with roof insulation manufacturer's recommendations. Mechanically fasten insulation to deck using approved fasteners. Fasteners shall penetrate insulation and deck. Tightly butt all insulation board joints. Fill joints wider than 1/4" as recommended by roofing membrane manufacturer.
   1. Do not install insulation faster than can be immediately covered with roofing.
   2. Do not leave uncovered edges or surfaces of insulation at the end of the day.
   3. Conform to FM recommendations for fastener spacing at roof perimeters and corners.
   4. Joints of multiple later insulation should be staggered over joints of the underlying insulation.
   5. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and adhere to insulation.

B. Elastomeric Membrane: Comply with roofing manufacturer's instructions and recommendations for handling and installing elastomeric membrane roofing.
   1. Start at low point of roof and work towards high point to minimize entry of water under the roofing system or as recommended by the manufacturer.
   2. Unroll and position roofing sheet membrane without stretching. Allow membrane to "relax" for at least 30 minutes before adhering, splicing and flashing.
   3. Position adjoining sheets in the same manner providing proper lap at edges for splicing and at adjacent vertical surfaces.
   4. Apply bonding adhesive to both sheet membrane and substrate surfaces and fully adhere sheet membrane to the substrate in accordance with manufacturer's recommendations. Broom bonded membrane to achieve maximum contact.
   5. Clean overlap areas of sheets. Join overlaps with splice cement, roll splices, and seal with lap sealant in accordance with manufacturer's recommended lap splice procedure.

C. Flash and make watertight equipment curbs for mechanical equipment located on the roof.

D. General flashing details for roof penetrations, curbs, parapets and roof perimeters shall comply with roofing material manufacturer's standard details and recommendations for flashings.
   1. Provide base flashing at perimeters and edges of membrane abutting parapets, walls, curbs or other construction. Provide prefabricated pipe seals for pipe and conduit penetrations, properly cemented to membrane and sealed to pipe or conduit with stainless steel clamp and top bead of sealant.
   2. Mechanical fasteners below counterflashing, where required at perimeter flashings, to be fully enclosed with suitable membrane to form water tight seal.
3. Minimum height of membrane flashing terminations to be 8" above top of membrane, unless otherwise indicated.

E. Install roof flashing and sheet metal work furnished under Section 07 62 00.
   1. Metal Coping: Provide membrane flashing under all new copings.
      a. At Coping Adjacent to Roof: Extend base flashing up parapet and over top of coping; extend down exterior face of coping approximately 2".
      b. At Independent Copings: Provide membrane flashing over top of wall and extend down both sides approximately 2".

F. Walkways: Install walkways where indicated on drawings. Adhere walkway pads to membrane. Maintain approximately 4" between pads.

G. Blocking Shim blocking solidly as required to make top surface of blocking level with top of insulation.

3.04 CLEANING AND PROTECTION

A. Patch installations by other trades and make all necessary repairs as required.

B. Upon completion of roofing work, clean gutters and drains of foreign materials and aggregate and remove all debris and surplus materials.

C. Protect finished roof areas from foot traffic and construction damage until final acceptance.

END OF SECTION
SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide flashing and sheet metal work as shown and specified. Work includes:
   1. Flashing, counter flashing, copings and edge conditions (gravel) stops.
   2. Miscellaneous flashings (step, drip, flat/slope roof transition, etc.).
   3. Miscellaneous rooftop concealed flashing.
   4. Sheet metal roofing and related flashing, trim and accessories.
   5. Fasteners, sealants, solder and accessories to complete the work.

1.02 RELATED SECTIONS

A. Masonry Flashing: Section 04 22 00.

B. Metal Wall Panels: Section 07 42 13

1.03 QUALITY ASSURANCE

A. Comply with Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) "Architectural Sheet Metal Manual" recommendations for fabrication and installation of the work.

B. Reference Standards

C. Subcontractor: Subcontract sheet metal associated with roofing as a part of the roofing contract for undivided responsibility.

D. Attachments to or penetrations in roofing systems to be made only with full approval of roofing manufacturer. Obtain approvals as required for installation of work under this section. Notify Architect if deviations from documents is required to obtain approval from roofing manufacturer prior to fabrication.

E. SPRI Wind Design Standard: Manufacture and install copings and fascia tested according to SPRI ES-1 and capable of meeting the design pressures indicated on the Structural Drawings.
F. Painted Finishes: Factory painted finish to be performed by an applicator specifically approved by the paint manufacturer. The applicator shall provide written notification of approval by paint manufacturer prior to application of finish.

1.04 SUBMITTALS

A. Shop Drawings and Product Data: Submit on all sheet metal work specified herein. Drawings to show all expansion joint details, joint details, waterproof connections to adjoining work and at obstructions and penetrations, methods of attaching to building and all formed sections. Include the following:
   1. Coping, edge condition stops and pre-finished components as detailed.

B. Submit 8" square material samples for each type of sheet metal required.

C. Submit full width by 8" long samples of all manufactured and fabricated items. Provide with specified finish and color.

1.05 PROJECT CONDITIONS

A. Do not proceed with the installation of flashing and sheet metal work until substrate construction, blocking and other construction to receive the work are completed.
   1. Metal roofing work is to follow progress of substrate as close as practical to limit exposure of insulation and wood materials.

1.06 WARRANTY

A. Contractor's warranty required for membrane roofing system work shall include all related roof flashing and sheet metal work. Refer to Section 07 53 23.

B. Provide Contractor's guarantee for all sheet metal work under this Section to be free from defects of material and workmanship for a period of two years. Work that is not watertight or is damaged by winds that do not exceed 90 mph will be considered defective.

C. Provide manufacturer's guarantee of paint finish against failure of paint finish. Failure includes blistering, peeling, cracking, flaking, checking, excessive color change and chalking. Color change shall not exceed 5 N.B.S. units (per ASTM D523) and chalking shall not less than a rating of 8 per ASTM D4214.
   1. Warranty Period: 20 years.

PART 2 PRODUCTS

2.01 MATERIALS

A. Prefinished Aluminum Sheet - All Flashings Exposed to View (*use where flashing material contacts aluminum finish surfaces*)
   1. Description: 3004 alloy aluminum sheet with factory applied finish.
   2. Finish
      a. Exposed Surfaces
         1) Material/Manufacturer: Fluoropolymer baked enamel finish
with Kynar 500 (70%) resins by ELF ATOCHEM OF NORTH AMERICA INC.; "Trinar" by AKZO; "Duranar" by PPG; "Fluropon" by VALSPAR or equal. Total dry film thickness not less than 1.0 mils.


3) Color: As selected by Architect from paint manufacturer’s complete specified line.

4) Application: Apply coating systems in strict accordance with manufacturer's printed instructions and recommendations. Refer to Quality Assurance in Part 1.

b. Concealed Surfaces: Can be manufacturer's standard coating for concealed surfaces.

3. Thicknesses: Provide the following minimum thicknesses:
   a. Flashing and Counterflashing: .032”.
   b. Coping: .040”.
   c. Edge Conditions (Gravel) Stop/Fascia: .040”
   d. Miscellaneous Flashing (not otherwise identified): .032”.

B. Galvanized Steel Sheet - All Flashings Exposed to View (use where flashing material contacts non-aluminum finish surfaces)

1. Material: Galvanized steel, ASTM A653, G90 coating factory applied finish

2. Finish
   a. Exposed Surfaces
      1) Material/Manufacturer: Fluoropolymer baked enamel finish with Kynar 500 (70%) resins by ELF ATOCHEM OF NORTH AMERICA INC.; "Trinar" by AKZO; "Duranar" by PPG; "Fluropon" by VALSPAR. Total dry film thickness not less than 1.0 mils
      2) Reference: Meet the requirements of AAMA 621, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
      3) Color: As selected by Architect from paint manufacturer’s complete specified line.
      4) Application: Apply coating systems in strict accordance with manufacturer's printed instructions and recommendations. Refer to Quality Assurance in Part 1.
   
   b. Concealed Surfaces: Can be manufacturer's standard coating for concealed surfaces.

3. Thicknesses: Provide the following minimum thicknesses:
   a. Flashing and Counterflashing: 0.0276
   b. Copings: 0.0396”. (20 gauge)
   c. Edge Conditions (Gravel) Stop/Fascia: .0396”
   d. Others: 0.0276”. (24 gauge)

C. Miscellaneous Flashing - Not Exposed to View: Galvanized steel, ASTM A653 G60. Mill phosphatized for paint adhesion. 0.0276”, (24 gauge) minimum unless otherwise indicated.
D. Stainless Steel: AISI Type 304; .018” thick; ASTM A240.
   1. Finish: NAAMM Manual AMP 503; Type 2D – Dull stainless steel finish; Architectural Quality

E. Fasteners: Provide same metal as sheet metal or other non-corrosive compatible metal recommended by sheet metal manufacturer.

F. Bituminous coating: Acid and alkali resistant solvent type black bituminous mastic.

G. Joint Sealants: See Section 07 92 00. Color matched to factory finished materials at roofing, fascia, coping and similar type systems.

H. Metal accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work; matching or compatible with material installed, non-corrosive, size and gage as required for performance.

I. Underlayment
   1. Membrane: Bituthene Ice and Water Shield by W. R. GRACE; Polyken 640 Underlayment Membrane by POLYKEN TECHNOLOGIES; Polyguard Deck Guard by POLYGUARD PRODUCTS; Weather Watch by GAF; Winterguard by CERTAINTEED, a modified bituminous membrane, minimum 40 mils thick, self-adhering, self-sealing moisture barrier.

J. Wood members: Requirements of Rough Carpentry, Section 06 10 00.

2.02 PREFABRICATED MATERIALS

A. Coping
   1. Fabricated in 10'-0" lengths to sizes indicated of 0.063" smooth aluminum. Provide manufacturer’s standard 12" wide, 20 gage perforated galvanized steel cleats, molded styrene or aluminum gutter chairs and special adhesive for cleat installation. Coping cover snapped-on to cleat spaced 5'-0" on center.
   2. Special Shapes: Provide units fabricated to radius indicated on drawings and to curve indicated on drawings. Provide metal locking corners.
   3. Provide factory welded and mitered corners, butt joints and concealed .032" aluminum cover plates.
   4. Manufacturers
      a. HICKMAN, W. P. COMPANY; “Permasnap Coping”.
      b. PETERSEN ALUMINUM CORP.; “Tite-Loc Coping”.
      c. ARCHITECTURAL PRODUCTS CO.; “Snap-Tight Coping”.
      d. CARLISLE SYN TEC, INC.; “SecurEdge 200 Coping”.
      e. FIRESTONE BUILDING PRODUCTS; “Firestone Coping System”.
      f. JOHNS MANVILLE, INC.; “Presto Lock Coping System”.

B. Edge Conditions (Gravel) Stop
   1. Fabricated in 10'-0" lengths to sizes indicated of 0.05" smooth aluminum, formed. Provide with galvanized spring clip (retainer) spaced at 12" o.c.
   2. Provide factory welded and mitered corners, butt joints and concealed .032" aluminum cover plates.
3. Manufacturers
   a. W.P. HICKMAN CO., Model No. TE 8.25.
   b. METAL-ERA, INC.; Anchor-Tite Fascia.
   c. CARLISLE SYN TEC, INC.; Secur Edge 300 Fascia System.
   d. FIRESTONE BUILDING PRODUCTS; Edge Guard and Fascia.
   e. JOHNS MANVILLE, INC.; Presto-Lock Fascia System.

C. Reglet and Counterflashing
   1. Description: Surface mounted type, roll formed, prefinished aluminum.
   2. Manufacturer
      a. METAL ERA, INC. two-piece Reglet #CFR2-500
      b. CHENEY FLASHING COMPANY; “Type B Reglet”.
      c. FRY REGLET CORPORATION; “MA Masonry Reglet”.
      d. W. P. HICKMAN CO.; “Drive-Lock-In-Wall Counter Flashing”.

D. Soffit Panels: Aluminum, solid and ventilated type. Formed to approximately 3/8" thick panel with reveals at approximately 5"-6" on center.
   1. Finish: Match type specified hereinbefore.
   2. Colors: As selected by Architect.
   3. Provide all trims, carriers and fasteners required for a complete installation.
   4. Manufacturer: REYNOLDS METALS COMPANY Double 5 ReynoGuard Soffit, ALCOA Traditional Select or equal.

E. Finish
   1. Exposed Surfaces
      a. Material/Manufacturer: Fluoropolymer baked enamel finish with Kynar 500 (70%) resins by ELF ATOCHEM OF NORTH AMERICA INC.; “Trinar” by AKZO; “Duranar” by PPG, “Fluropon” by VALSPAR. Total dry film thickness not less than 1.0 mils
      c. Color: As selected by Architect from manufacturer’s complete line.
   2. Concealed Surfaces: Can be manufacturer's standard coating for concealed surfaces.

2.03 FABRICATION

A. Shop fabricate sheet metal work to comply with standard industry standards as shown by SMACNA in the "Architectural Sheet Metal Manual."

B. Form sections square, true and accurate to size and profile, free from distortion and other defects detrimental to appearance or performance. Make all lines, edges, angles and moldings straight, sharp, true; reinforce for rigidity and strength.

C. Fabricate for watertight and weatherproof performance with expansion provisions for running work, sufficient to permanently prevent leakage, damage or
deterioration of the work. Form exposed sheet metal work with exposed edges folded back to form hems. Fabricate with seams overlapping in the direction of water flow.

D. Fabricate non-moving seams in sheet metal with flat lock or butt hairline joints except as otherwise indicated. Fabricate corners mitered, soldered and sealed as one piece. Locate corner joints 2'-0" from corners and intersections.

E. Seal movable non-expansion type joints with joint sealant. Form joints as indicated, if not, in compliance with industry standards to receive joint sealants.

F. Provide for separation of metal from non-compatible or corrosive substrates by coating concealed surfaces with bituminous coating or other permanent separation as recommended by the sheet metal manufacturer.

G. Coping - Shop formed: SMACNA Page 3.9 (Figure 3-4) and 3.13 (Figure 3-6), as applicable with continuous cleats both sides and concealed fasteners. Slope to drain towards roof. Corners to be mitered and soldered or welded.
1. Seams: SMACNA table 3-1 on Page 3.4. Butt joint and backup plate type, 12" wide centered on joint.
2. Cleats: 0.050" stainless steel.

H. Trim for Roof Hatches: Provide galvanized sheet metal trim to cover all construction from bottom of roof deck to hatch or vent.
1. Trim to form 90° bend at bottom of roof deck with minimum 3-inch return and lap hatch or vent curb not less than 2".
2. Provide hemmed edge at curb.
3. Provide lapped covers for joints or corners if trim package fabricated from more than one piece. Joint covers to lap joints by minimum 2" and have hemmed edges.

**PART 3 EXECUTION**

3.01 PREPARATION

A. Examine substrates and installation conditions. Do not install flashing and sheet metal work until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

C. Coordinate flashing and sheet metal work with other work for the correct sequencing of items which make up the entire membrane or system of weatherproofing and rain drainage.

3.02 INSTALLATION

A. Comply with SMACNA "Architectural Sheet Metal Manual" recommendations, and drawing details for installation of the work.
B. Install prefabricated items in accordance with manufacturer's instructions and recommendations.

C. Anchor units securely in place by methods indicated, providing for thermal expansion. Conceal fasteners and expansion provisions whenever possible. Install joint sealants where indicated.

D. Set units true to lines and levels indicated. Install work with laps, joints and seams which will be permanently watertight and weatherproof.

E. Separate sheet metal work from dissimilar metals, treated wood, and cementitious materials. Provide roofing felt underlayment and rosin-sized paper slip sheet over treated wood surfaces.

F. Fabricate, support and anchor downspouts in a manner which will withstand thermal expansion, stresses and full loading by ice or water without damage, deterioration or leakage.

G. Continuously seal exposed joints where flashing or counter flashing terminates into reglets after sheet metal is adequately wedged and secured.

H. Metal flashings which may be built into masonry mortar joints shall be preformed with corrugations, ribs or crimps which will maintain integrity of mortar bond for masonry.

I. Coping
   1. Install membrane roofing flashing over top of parapet substrate prior to installing coping. See Section 07 53 23. Coordinate installation.
   2. Apply continuous bead of sealant on both sides of joints immediately prior to setting coverplates.

END OF SECTION
SECTION 07 81 10
SPRAY-APPLIED FIREPROOFING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide rated installations which comply with indicated ratings for fire endurance, flame spread, and combustibility; including applicable code interpretations by governing authorities, and listing and labeling by UL or FM where applicable.

B. This Section includes both mineral fiber type and cementitious type fireproofing. Unless otherwise indicated, the Contractor may use either type of fireproofing on the project. A combination of types may be used (i.e. mineral fiber type on decks and cementitious type on framing members).
   1. However, unless otherwise indicated, one type shall be used throughout the entire project for each type of application (i.e. the same type shall be used for all beams; the same type for all decks; etc).

1.02 RELATED SECTIONS

A. Firesafing: Section 07 84 00.

B. Structural Steel: Section 05 12 00.

C. Sustainable Design Requirements: Section 01 81 13.

1.03 QUALITY ASSURANCE

A. Applicator: Acceptable to fireproofing manufacturer.

B. Regulatory Requirements
   2. Conform to IBC for fire resistance ratings.

C. References: Wherever the following abbreviations occur, they shall refer to the corresponding standard:

1.03 SUBMITTALS

A. Manufacturer’s Product Data: Submit for all items. Include instructions for bonding and applying fireproofing.

B. Submit copies of certified test reports of:
1. Manufacturer’s certification or independent test reports confirming that materials meet or exceed performance criteria specified.
2. Reports from independent testing agencies of product proposed for use, which indicate conformance to ASTM E84 and E119.

C. Special Environmental Requirements: Submit the following in accordance with Section 01 81 13: Product documentation indicating VOC Content

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original unopened packages bearing the manufacturer’s name, brand and UL label verifying compliance with UL’s quality control inspection program and the appropriate fire resistance ratings.

B. Keep materials dry until ready for use. Keep materials off the ground, under cover and away from sweating walls and other damp surfaces. Discard materials that have been exposed to water before actual use.

1.05 JOB CONDITIONS

A. Environmental Requirements
1. Do not apply fireproofing when temperature of substrate, material and surrounding air is below 40°F. Maintain temperature 24 hours before and 24 hours after application of fireproofing.
2. Provide ventilation in areas to receive fireproofing during and for 24 hours after application, to help dry material and maintain nontoxic, unpolluted working area.

PART 2 PRODUCTS

2.01 MINERAL FIBER TYPE

A. Materials
1. Metal Lath: 3.4 pound per square yard expanded diamond steel lath, galvanized finish; with reinforcing members, anchorage and accessories as appropriate for substrate conditions and applications indicated.
2. Sprayed-On Mineral Fiber Fireproofing: Non-combustible (ASTM E136), non-asbestos, mineral fiber mixed with binders, fillers and additives for spraying in place to form a rigid, porous fireproofing blanket with thermal insulating K value of 0.30 at 75°F.
3. Sealer: Manufacturer’s standard sprayed-on resinous coating, for control of dusting without significant increase in surface burning characteristics. Color tinted to distinguish sealed fireproofing from unsealed.

B. Manufacturer: Specifications are based on ISOLATEK INTERNATIONAL (CAFCO). Equal products manufactured by AMERICAN SPRAYED FIBERS INC. and AD FIRE PROTECTION SYSTEMS (SOUTHWEST FIREPROOFING) are acceptable providing the performance requirements specified herein are maintained.
C. Performance Requirements: Factory mixed material applied to provide compliance with specified performance specifications and test criteria.
   1. Dry Density: No less than 12 pcf.
   2. Deflection - ASTM E759: No cracks or delaminations.
   4. Air Erosion - ASTM E859: Maximum allowable weight loss of the fireproofing material is .025 gm./sq. ft.
   5. Compressive Strength - ASTM E761: The fireproofing shall not deform more than 10 percent when subjected to 500 psf compressive forces.
   6. Surface Burning Characteristics - ASTM E84:
      Flame Spread: 10.
      Smoke Developed: 0.
   7. Indentation Hardness - ASTM C569: Less than 0.50 inch.

D. Water: Clean; potable.

E. Hour Ratings and UL Test Designs: As indicated on drawings.

2.02 CEMENTITIOUS TYPE

A. Type: Spray applied cementitious fireproofing.

B. Manufacturer: Specifications are based on MK-6 by W. R. GRACE. Equal products by ISOLATEK INTERNATIONAL (CAFCO), AD FIRE PROTECTION SYSTEMS (SOUTHWEST FIREPROOFING), CARBOLINE COMPANY or ALBI MANUFACTURING are acceptable providing the performance requirements specified herein are maintained.
   1. Fibrous Ingredients: Asbestos or mineral wool are not permitted; comply with OSHA Regulation 29, FR, 1926.58.

C. Factory mixed material applied to provide compliance with specified performance specifications and test criteria.
   1. Dry Density: The field density shall be measured in accordance with ASTM Standard E605. Minimum average density shall be that required by the manufacturer, listed in the UL Fire Resistance Directory for each rating indicated, ICBO Evaluation Report, as required by the authority having jurisdiction, or minimum average 15 pcf, whichever is greater.
   2. Deflection: Material shall not crack or delaminate when tested in accordance with ASTM E759.
   3. Impact Resistance: Fireproofing material tested in accordance with ASTM E760 shall not crack or delaminate.
   4. Bond Strength: Fireproofing, when tested in accordance with ASTM E736, shall have a minimum average bond strength of 200 psf and a minimum individual bond strength of 150 psf.
   5. Air Erosion: Maximum allowable total weight loss of the fireproofing material shall be .005 g/ft$^2$ when tested in accordance with ASTM E859. Sample surface shall be “as applied” (not pre-purged) and the total reported weight loss shall be the total weight loss over a 24 hour period from the beginning of the test.
   6. Compression: The fireproofing shall not deform more than 10 percent
when subjected to 1200 psf compressive forces in accordance with ASTM E761.

7. Corrosion Resistance: Steel shall be tested in accordance with ASTM E937 without evidence of corrosion of the steel.

8. Surface Burning Characteristics - ASTM E84:
   Flame Spread: 0.
   Smoke Developed: 0.

9. Resistance to Mold: The fireproofing material shall be formulated at the time of manufacturing with a mold inhibitor. Fireproofing material shall be tested in accordance with ASTM G21 and shall show resistance to mold growth for a period of 28 days for general use.

10. Combustibility: Material shall have a maximum total heat release of 20 MJ/m$^2$ and a maximum 125 kw/m$^2$ peak rate of heat release 600 seconds after insertion when tested in accordance with ASTM E1354 at a radiant heat flux of 75 kw/m$^2$ with the use of electric spark ignition. The sample shall be tested in the horizontal orientation.

11. VOC Content: 0.0 g/L.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that surfaces to receive fireproofing material are free of oil, grease, loose mill scale, or other substances which may impair proper adhesion.

B. Confirm compatibility of surfaces to receive fireproofing material.

C. Verify clips, hangers, supports, sleeves and other items required to penetrate fireproofing are in place.

D. Verify ducts, piping, equipment or other items which would interfere with application of fireproofing materials are not positioned until fireproofing work is completed.

E. Beginning of installation means acceptance of substrates and installation conditions.


3.02 PROTECTION

A. Protect adjacent surfaces and equipment from damage by overspray, fallout and dusting.

B. Close off and seal ductwork in areas where fireproofing is being applied.

C. Protect applied sprayed fireproofing from damage.
3.03 APPLICATION

A. Apply fireproofing in strict accordance with manufacturer’s instructions.

B. Apply fireproofing in sufficient thickness to achieve rating with as many passes as necessary to cover with monolithic blanket of uniform density and texture.

C. Apply adhesive as recommended by fireproofing manufacturer to horizontal surfaces.

D. Apply sealer to all mineral fiber type fireproofing. Apply at rates as indicated by manufacturer.

3.04 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect fireproofing and patch any damaged or removed areas.

3.05 CLEANING

A. After completion of fireproofing work, equipment shall be removed and all exposed wall and floor areas shall be left in a broom-clean condition.

END OF SECTION
PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide firestop systems consisting of a material, or combination of materials installed to retain the integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and/or hot gases through penetrations, openings, construction joints or at perimeter fire containment in or adjacent to fire-rated barriers in accordance with requirements of local Codes.

B. Firestopping shall be used in locations including, but not limited to, the following:
   1. Penetrations through fire resistance rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
   2. Penetrations through fire resistance rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
   3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
   4. Sealant joints in fire resistance rated construction.
      a. Gaps between the top of walls and ceilings, floor or roof assemblies; includes filling metal deck flutes where applicable.
      b. Openings around structural members penetrating floors or walls.
      c. Control joints.
      d. Floor joints not requiring expansion joints.
   5. Walls enclosing plenum spaces, rated and unrated.
      a. Gaps between the top of walls and ceilings or roof assemblies.
      b. Openings around items which penetrate walls.
   6. Other locations indicated.

1.02 RELATED SECTIONS

A. Masonry: Section 04 22 00.

B. Spray-applied Fireproofing: Section 07 81 10.

B. Gypsum Wallboard: Section 09 21 16.

C. MPE: Plumbing (Division 22); HVAC (Division 23); Electrical (Division 26).

1.03 DEFINITIONS

A. Firestopping: Material or combination of materials (assembly) to retain integrity of fire rated construction by maintaining an effective barrier against the spread of flame, smoke, and gases.
B. Through-penetration: Any penetration of a fire-rated wall or floor that completely breaches the barrier.

C. Through-Penetration Firestop Systems: Material or combination of materials which are field constructed of fill, void, or cavity materials and forming materials, designed to resist fire spread when installed as a complete firestop system.

D. Through-Penetration Firestop Devices: Factory built products designed to resist fire spread. Complete when delivered to site; ready for installation.

E. System: The use of a specific firestop material or combination of materials in conjunction with a specific wall or floor construction type and specific penetrants.

F. Barrier: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.

G. Membrane-penetration: Any penetration in a fire-rated wall that breaches only one side of the barrier.

H. Fire Resistive Joint: Any gap, joint, or opening, static or dynamic, between two fire rated barriers including where the top of a wall meets a floor; wall edge to wall edge applications; floor edge to floor edge configurations; floor edge to wall.

I. Perimeter Barrier: Any gap, joint, or opening, whether static or dynamic, between a fire rated floor assembly and a non-rated exterior wall assembly.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM)
   4. E2174: Standard Practice for On-Site Inspection of Installed Fire Stops

B. National Fire Protection Association (NFPA)
   1. 70: National Electrical Code (NEC)

C. Underwriters’ Laboratories (UL)
   1. UL1479: Fire Tests of Through Penetration Fire Stops.
   2. UL2079: Tests for Fire Resistance of Building Joint Systems

D. Firestop Design Classification References
   1. Warnock Hersey Listing Manual
   2. UL Fire Resistance Directory - Vol. 1

E. Factory Mutual (FM) Research
   1. FM Approval Standard of Firestop Contractors – Class 4991

1.05 SYSTEM PERFORMANCE REQUIREMENTS
A. System Design and Product Selection: Contractor responsible for selection of products and tested designs that fulfill the firestopping requirements of this section.

B. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gasses.

C. F-Rated Through Penteration Firestop Systems: Provide through penetration firestop systems with F ratings indicated as determined per ASTM E814, UL 1479 but not less than that equaling or exceeding the fire resistance rating of the constructions penetrated.

D. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where specified by codes or where the following conditions exist:
   1. Where firestop systems protect penetrations outside of wall cavities.
   2. Where firestop systems protect penetrations located outside fire resistive shaft enclosures.
   3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature rise rating.
   4. Where firestop systems protect penetrating items larger than a 4 inch diameter nominal pipe or 16 square inch in overall cross sectional area.

E. L – Rated Through-Penetration Firestop Systems: Provide firestop systems with L ratings, in addition to F and T ratings, as determined per UL 1479, where indicated by Code.

F. Fire Resistive Joint Sealants: Provide joint sealants with fire resistance ratings indicated, as determined per ASTM E119, UL 1479 and UL 2079 but not less than that equaling or exceeding the fire resistance rating of the construction in which the joint occurs.

G. For firestopping exposed to traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions and will meet load requirements.
   1. For piping penetrations for plumbing and wet pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
   2. For floor penetrations with annular spaces exceeding 4" in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads either by installing floor plates or by other means.
   3. For penetrations involving insulated piping, provide through-penetration firestop systems not required removal of insulation.

H. For through-penetration firestop systems exposed to view, provide products with flame spread of less than 25 and smoke developed ratings of less than 450, as determined per ASTM E84.

I. Where there is no specific third party tested and classified firestop system available for an installed condition, obtain from the firestopping material

D.P. Culp Center [TBR SBC No. 166/005-01-2014A] 07 84 00 - 3
East Tennessee State University 50% CD FIRESTOPPING
manufacturer an Engineering Judgment (EJ) to be submitted to the Approving Authority and Authority Having Jurisdiction for approval prior to installation. The EJ shall follow International Firestop Council (IFC) guidelines.

1.06  SUBMITTALS

A. Submit in accordance with the requirements of Section 01 33 23 and the General Conditions (MNPS Section 00 80 00; Article 4.13).

B. Product Data: Manufacturer's specifications and technical data for each material including composition and limitations, documentation of UL or other nationally recognized independent testing laboratories firestop systems to be used, and manufacturer's installation instructions. Manufacturer's engineering judgement identification number and drawing details if no tested system available.

C. Shop drawings detailing materials, installation methods, and relationships to adjoining construction for each through-penetration firestop system, and each kind of penetrating item. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.
   1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop configuration for construction and penetrating items.
   2. Where project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration approved by firestopping manufacturer with modifications marked.

D. Product certificates signed by manufacturers of firestopping products certifying that their products and installation comply with specified requirements. Certification shall be signed by the Installer.

E. Certification is required from manufacturer that Installer has been trained in the handling and installation of their products.

F. Firestopping installer shall provide a letter of certification stating that all firestopping systems have been installed in accordance with the Contract Documents.

1.07  QUALITY ASSURANCE

A. Meet requirements of ASTM E814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated and other ASTM Standards as applicable for the installation.

B. Requirements of Regulatory Agencies: Comply with the applicable requirements for fire separations and penetrations of the following:
1. See local governing codes for the time rated construction requirements.
2. NFPA 70 and NFPA 101.

C. Installer: Specialist in the installation of type(s) of firestopping required; trained and approved by firestop manufacturer; and have successfully completed not less than 5 firestop projects similar in type and size to that of this Project.

D. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy".

E. Do not use any product containing solvents that require hazardous waste disposal or which after curing dissolve in water.

F. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.

G. Single Source Responsibility: Obtain firestop systems for each kind of penetration and construction condition indicated from a single primary firestop systems manufacturer.
   1. Materials of different manufacture than allowed by the tested and listed system shall not be intermixed in the same firestop system or opening.
   2. Tested and listed firestop systems are to be used before an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) is installed.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping undamaged products to project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacturer; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials. Comply with recommended procedures, precautions, or remedies described in material safety data sheets as applicable.

B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. Do not use damaged or expired materials.

1.09 PROJECT CONDITIONS

A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilation: Ventilate firestopping per firestopping manufacturers’ instructions by natural means or, where this is inadequate, forced air circulation.

1.10 SEQUENCING AND SCHEDULING
A. Coordinate this Work as required with work of other trades. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

B. Do not cover up those firestopping installations that will become concealed behind other construction until Owner's inspection agency and authorities having jurisdiction, if required, have examined each installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide products from one or more of the following manufacturers according to the suitability of the product for the intended purpose.
   1. W.R. GRACE (Flamesafe System)
   2. FYRESLEEVE INDUSTRIES
   3. TREMCO
   4. HILTI, INC.
   5. SPECIFIED TECHNOLOGIES (STI).
   6. 3M FIRE PROTECTION PRODUCTS.
   7. THE RECTORSEAL CORPORATION (Metacaulk and Bio Fireshield).
   8. NELSON FIRESTOP PRODUCTS.

2.02 MATERIALS - GENERAL

A. As selected by Contractor. See 1.05 - System Performance Requirements.

B. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
   1. All materials shall comply with ASTM E814 or E 119 (UL 1429), and shall be manufactured of nontoxic, non-hazardous, asbestos free materials, and unaffected by water or moisture when cured.
   2. Primers: Conform to manufacturer’s recommendations for primers required for various substrates and conditions.
   3. Backup Materials: Backup materials, supports, and anchoring devices shall be provided as required by UL testing.
   4. Provide all firestopping sealant materials within the VOC limits.

C. Accessories: Provide components for each firestopping system needed to install fill materials and to comply with "System Performance Requirements" in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire resistance rated systems. Accessories include but are not limited to the following items:
   1. Permanent forming/damming/backing materials must be noncombustible and may include the following:
      a. Semi-refractory fiber (mineral wool) insulation.
      b. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
2.03 RATED STUD DEFLECTION ASSEMBLY

A. Gypsum Wallboard: See Section 09 21 16.

B. Insulation: Mineral wool, 3.5 PCF minimum density.

C. Firestopping Compound: Types as manufactured by listed manufacturers in 2.01A

D. Accessories: Provide all fasteners, clips and other related installation accessories as required for a complete UL approved assembly.

2.04 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer’s written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions are corrected. Verify penetrations are properly sized and in suitable condition for application of materials.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
   1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
   2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer’s recommended products and methods. Confine primers to areas of bond; do not allow spillage and
migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop systems seal with substances.

3.03 INSTALLING THROUGH-PENETRATION FIRESTOPS

A. General: Comply with the "System Performance Requirements" in Part 1 and the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
   1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 INSTALLING FIRE RESISTIVE JOINT SEALANTS

A. General: Comply with the "System Performance Requirements" in Part 1 with ASTM C1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install joint fillers to provide support of sealants during application and at position required to produce the cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire resistance rating required.

C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

D. Tool non-sag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire resistance rating, as well as to eliminate air pockets,
and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.05 INSTALLING PERIMETER FIRE BARRIER SYSTEMS
A. General: Comply with “System Performance Requirements” article in Part 1 and with the firestop manufacture’s installation and drawings pertaining to products and applications indicated.

B. Install metal framing, curtain wall insulation, mechanical attachments, safing materials and firestop materials as applicable within the system design.

3.06 IDENTIFICATION
A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage".
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.

3.07 FIELD QUALITY CONTROL
A. The inspector shall advise the contractor of any deficiencies noted.

B. Do not proceed to enclose firestopping with other construction until inspection agency has verified that the firestop installation complies with the requirements.

C. Where deficiencies are found, repair or replace the firestopping so that it complies with requirements of tested and listed system design.

3.08 CLEANING
A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Contract Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop system complying with specified requirements.
END OF SECTION
SECTION 07 91 13
COMPRESSION SEALS

PART 1 GENERAL

1.01 WORK INCLUDED
A. Work in this section includes exterior vertical and horizontal expansion joint seals

1.02 RELATED SECTIONS
A. Expansion Joint Cover Assemblies: Section 07 95 13.
B. Sealants: Section 07 92 00.

1.03 SUBMITTALS
A. Manufacturer's Literature and Data
   1. Submit copies of MFR's current literature and data for each item specified
   2. Clearly indicate movement capability of cover assemblies and suitability
      of material used in exterior seals for ultraviolet exposure.
B. Certificates: Material test reports from approved independent testing laboratory
   indicating and interpreting test results relative to compliance of fire-rated
   expansion joint assemblies with requirements specified.
C. Shop Drawings
   1. Showing full extent of expansion joint cover assemblies; include large-
      scale details indicating profiles of each type of expansion joint cover
      assembly, splice joints between sections, joiners with other type
      assemblies, special end conditions, anchorages, fasteners, and
      relationship to adjoining work and finishes.
   2. Include description of materials and finishes and installation instructions.
D. Samples of each type and color of flexible seal used in work.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING
A. Deliver materials in the original, intact manufacturer labeled containers.

1.05 PROJECT CONDITIONS
A. Coordinate the installation of the joint system with related work. Protect installed
   units until completion of entire project.
B. Ambient temperature shall not be lower than 40°F during installation. Note that
   gap size will change with cold and hot temperature extremes. Gap measurement
   should optimally be carried out at the mid-point of the average temperature range
   for the area of installation.
C. Substrate Surfaces: Free of dust, oil, grease, wax, moisture, and frost. The gap wall surfaces must be thoroughly cleaned.

D. No installation performed in rainy weather, or if rain is expected within one hour before installation. All surfaces must be completely dry prior to installing system.

E. Upon completion of this work, remove trash and debris on the site caused by work under this section.

1.06 QUALITY ASSURANCE

A. Installer: Approved in writing by manufacturer.

B. Compression seal manufacturer representative will perform a quality assurance site visit, document completed compression seal installations and submit a written condition report with any action items.

PART 2 PRODUCTS

2.01 VERTICAL SEALS

A. Provide exterior seal consisting of a silicone pre-coated, preformed, pre-compressed, self-expanding, sealant system. Seal shall combine factory-applied, 15 Shore-A hardness, low-modulus silicone and impregnated expanding foam sealant. Joint Thicknesses: As indicated on drawings.

B. Materials

1. Expanding Polyurethane Foam: Open-cell foam impregnated with a waterproof polymer sealing compound; uncompressed foam impregnation density of to be minimum 9 lbs./cu.ft. as tested by ASTM D3575

2. Silicone External Color Facing: Factory-applied to the foam. Coating width to be a minimum of 1.75 -1.85 times the designed, or field measured, joint gap width. Colors: As selected by Architect.

3. Physical Properties: Manufacturer to certify that the material has been tested and meets the values in the table below and has been performance tested according to the listed performance tests and exhibits results that meet those listed below:

   a. Durometer Hardness-Silicone Coating; ASTM D2240, Shore A 15
   b. Ultimate Elongation; ASTM D3574: 105-145%.
   c. Tensile Strength; ASTM D3574: Minimum 21 psi.
   d. Thermal Conductivity; ASTM C518: 0.34 BTU. IN/HR. FT² °F.
   e. Water Penetration of Curtain Walls by Uniform Static Air Pressure Difference; ASTM E331: UP TO 20.88 PSF—PASSED
   f. Structural Performance of Curtain Walls by Uniform Air Pressure Diff. (Gust Loads); ASTM E330: +62.66 PSF, -56.39 PSF-Passed

C. Fabrication/Design

1. Supply seal pre-compressed to less than the joint size, packaged in shrink-wrapped lengths (sticks) with a self-adhesive on one face.

2. Depth of seal as recommended by manufacturer.
3. End to end joins of consecutive lengths of material to be joined by mitering and adhering as recommended by manufacturer. To obtain identical color sealant, use liquid silicone sealant supplied by manufacturer from same color batch as was used to form the bellows.

D. Drawings and specifications are based on Colorseal manufactured by EMSEAL or equal. Similar system manufactured by WATSON BOWMAN ACME, WILLIAMS PRODUCTS INC., SCHUL INTERNATIONAL or ERIE METAL SPECIALTIES is acceptable providing the system meets the performance requirements specified herein.

2.02 HORIZONTAL SEALS

A. Materials
2. Nosings: Cold applied; pourable two-part polyurethane material (epoxies not permitted) mixed with aggregate with sand particles not to exceed 30-mesh. Aggregate loading ratio by weight of liquid resin to aggregate not to exceed 1:2.

B. Joint Thicknesses: As indicated on drawings.

C. Physical Properties - Rubber Sealing Glands: Manufacturer to certify that the material has been tested and meets the values in the table below and has been performance tested according to the listed performance tests and exhibits results that meet those listed below:
   2. Ultimate Elongation; ASTM D412: 440%.
   3. Tensile Strength; ASTM D412: 1000 psi.

D. Drawings and specifications are based on Thermaflex TCR manufactured by EMSEAL. Similar systems by LYMTAL or WATSON BOWMAN ACME are acceptable providing system meets the performance requirements specified.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Joint configuration and the joint surfaces shall be as detailed in the drawings. All known detrimental conditions shall be reported immediately in writing.

B. Do not proceed with the installation of joint sealer if the joint is other than designed, until written notification of these conditions is submitted to the manufacturer and Architect, and a written acknowledgement with an order to proceed is provided.

C. Proceeding with joint sealer indicates conditions are acceptable to the installer.

3.02 INSTALLATION
A. Install in accordance with the manufacturer’s recommendations and instructions.

B. Cut profile to the correct length of the appropriate gap for installation, without pulling or exerting excess tension.

END OF SECTION
SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SCOPE

A. General: Prepare joints and apply sealant at all locations which normally require sealing to prevent infiltration of air, water, and insects and to reduce transmission of sound.

B. Apply sealants to exterior and interior non-static joints. Do not seal normal drainage points or weep holes. Include the following:
   1. masonry control and expansion joints.
   2. around louvers, exterior trim, windows, door frames, aluminum entrances and other penetrations or openings in exterior walls
   3. threshold bedding
   4. joints between different wall materials; stone joints.
   5. termination joints between wall materials and adjacent materials
   6. perimeter seal of metal door and borrowed light frames where they abut masonry and abut drywall in shower rooms, toilet rooms and kitchens
   7. composite wall panel joints
   8. other applications indicated

C. Sealing of joints in concrete construction, including sidewalk joints, concrete paving joints and floor joints, tile floor expansion joints and other floor joints as indicated.

D. Sealing of all exterior and interior locations where materials or equipment do not fit together or against the adjoining surface with a hairline joint.

E. Caulking of interior static joints. Include the following:
   1. intersection of exposed structure or ceiling construction with masonry walls
   2. perimeter seal of metal door and borrowed light frames where they abut drywall, except in shower rooms, toilet rooms and kitchens
   3. intersection of grilles and louvers with adjacent surfaces
   4. intersection of cabinets/casework, similar items applied to/recessed in walls
   5. other applications indicated

F. Sealing between wall and wall mounted plumbing fixtures and floor and floor mounted plumbing fixtures.

G. Sealing at intersection of plastic laminate tops and side/backsplashes to each other and to wall. Seal penetrations through ceramic tile work.

H. Sealing at reglets and flashings set in sealant.

I. Joints, perimeter, and penetrations in fire-rated assemblies. Use firestopping specified in Section 07 84 00.
J. Trim exposed masonry flashing.

K. Joints, perimeter, and penetrations in sound-rated assemblies; Section 09 21 16.

1.02 RELATED SECTIONS

A. Firestopping Sealants: Section 07 84 00.

1.03 GENERAL PERFORMANCE

A. Except as otherwise indicated, joint sealant is required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application.

B. Failures of installed sealant to comply with this requirement will be recognized as failures of both materials and workmanship.

1.04 SUBMITTALS

A. Submit manufacturer's product data and installation instructions.
   1. Certification, in the form of manufacturer's standard data sheet or by letter, stating that each type of compound and sealant to be furnished complies with these specifications.
   2. Statement that each product to be furnished is recommended for the application shown and is compatible with all materials to which applied.
   3. Instructions for handling, storage, mixing, priming, installation, curing and protection for each type of sealant.

B. Submit manufacturer's color chart for color selections.

C. Submit cured sealant samples in colors required for the work. A/E's approval will be for color only; compliance with other requirements is Contractor's responsibility.

D. Stone and sealant test reports for each type of stone used.

1.05 STORAGE AND HANDLING

A. Prevent inclusion of foreign matter or damage of materials by water or breakage. Materials showing evidence of damage shall be rejected.

B. Procure and store in original containers until ready for use.

1.06 WARRANTY

A. Installer's Warranty: Contractor and joint sealant applicator shall jointly warranty joint sealant work for two (2) years from date of final acceptance. Warranty shall include replacing joints which fail to perform as airtight; or fail in adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration and stain resistance, general durability or any other form of apparent deterioration (excluding inherent qualities and limitations clearly specified in the manufacturer's submitted product data).
B. Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section for ten (10) years from date of final acceptance.

C. Warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.

D. Comply with these specifications for repair or replacement of work.

1.07 STONE SEALANT TESTS

A. Provide test reports per ASTM E575 on the stone and sealant materials and methods proposed for this project which will demonstrate successful behavior of sealant systems under limited design stresses with respect to adhesion, compatibility, migration, stability, cohesion, staining, recovering and any other deleterious effects.

B. Provide a procedure detailing cleaning, priming, taping, tooling and other steps recommended to ensure satisfactory function and appearance.

C. Submit documentation of product performance as required per ASTM C920.

D. Perform the same testing but substitute actual job substrate materials in lieu of standard test materials, e.g., in ASTM C1248, use job stone samples in lieu of white cement mortar. Test long term behavior, under compression.

PART 2 PRODUCTS

2.01 MATERIALS

A. Definition: The term "sealant" will be understood to be an elastomeric type. The term "caulk" will be understood to be a synthetic resin base of highest quality acrylic latex compound.

B. General
   1. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
   2. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the limits for VOC content calculated according to 40 CFR 59, Subpart D (EPA Method 24):
a. Architectural Sealants: 250 g/L.
b. Sealant Primers for Nonporous Substrates: 250 g/L.
c. Sealant Primers for Porous Substrates: 775 g/L.

3. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

4. Colors: As selected by Architect from manufacturer's full range; selected colors to match adjacent materials.

5. Where exposed to foot traffic, select materials of sufficient strength and hardness to withstand stiletto heel traffic without damage or deterioration of sealant system.

C. Manufacturers: BOSTIK; DOW CORNING CORP; EUCLID CHEMICAL; TREMCO MANUFACTURING CO.; GENERAL ELECTRIC CO. / MOMENTIVE; SIKA CHEMICAL CO.; MAMECO INTERNATIONAL; BASF BUILDING SYSTEMS; VULCHEM. Manufacturer's listed under the following applications are for basis of design. Equal products by above listed manufacturers are acceptable.

D. Exterior Vertical and Overhead Joints: Single-component neutral curing silicone sealant meeting ASTM C920, Type S, Grade NS, Class 50.
   1. DOW 791
   2. GE SCS9000 Silpruf NB
   3. TREMCO Spectrum 2
   4. PECORA 895 NST

or

D1. Exterior Vertical and Overhead Joints: Single or multi-component elastomeric polyurethane sealant meeting ASTM C920, Type M or S, Grade NS, Class 50.
   1. PECORA Dynatrol II
   2. TREMCO Dymeric 240
   3. BOSTIK Chem-Calk 2020
   4. PACIFIC POLYMERS INTERNATIONAL Elastothane230 LM Type II
   5. POLYMERIC SYSTEMS INC. PSI-901

E. Horizontal Wearing Expansion Joints; Interior and Exterior
   1. Type: Two-part polyurethane based elastomeric sealant, complying with ASTM C920, Class 25, Type M, Grade P. Self-leveling or gun grade type as recommended by manufacturer for application shown.
   2. Location: For joints in exterior concrete pavements, sidewalks and interior floors.
      a. BOSTIK Chem-Calk 555-SL
      b. EUCLID Eucolastic II
      c. SONNEBORN Sonolastic SL 2
      d. TREMCO THC 900/901

F. Interior Vertical and Overhead Joints: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
   1. DOW 799
   2. GE SCS2000 SilPruf
   3. TREMCO Spectrum 2
   4. PECORA 895 NST

or
F1. Interior Vertical and Overhead Joints: Single or multi-component polyurethane gun-grade, non-sag sealant complying with ASTM C920, Type S or M, Class 25, Use NT, M, A, Grade NS.
   1. EUCLID Eucolastic I or II
   2. BASF Sonolastic NP 1 or NP 2
   3. BOSTIK Chem-Calk 900
   4. TREMCO Dymonic

G. Sealants at Countertops, Backsplashes and Plumbing Fixtures: ASTM C920, Type S, Grade NS, Class 25. Provide with mildew resistive additive.
   1. Sealant Colors
      a. Countertops and Backsplashes: Clear.
      b. Plumbing Fixtures: white, unless colored fixtures are selected, then sealant color shall match fixture color.
   2. Manufacturers/Products
      a. DOW 786
      b. GE SCS1700 Sanitary.
      c. SONNEBORN Sonolastic Omniplus
      d. TREMCO Tremsil 600
      e. PECORA 898 Sanitary Sealant

H. Caulk Joints – Interior, Static - Paintable: High quality acrylic latex compound, non-staining non-bleeding complying with ASTM C834, as supplied by one of the above listed manufacturers.

I. Exterior and Interior Joints Subject to Water Immersion: Two-part elastomeric polysulfide sealant, meeting ASTM C920, Type M, Grade NS, Class 25.
   1. SONNEBORN Sonolastic Two-Part
   2. EPOXY SYSTEMS 913
   3. CMI Sealtight Deck-O-Seal

2.02 ACCESSORIES

A. Joint Primer/Sealer: Non-staining type, recommended by sealant manufacturer; compatible with joint forming material.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming material.

C. Bond Breaker Tape: Pressure sensitive polyethylene or plastic tape, recommended by sealant manufacturer, to suit applications where bond to substrate should be avoided for proper joint sealant performance.

D. Joint Backing: Compressible rod stock conforming to ASTM C1330, Type B; material as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance

E. Solvents: Cleaning agent recommended by the manufacturer of the sealant in writing to Architect.
F. Expanding Control Joint Filler
   1. Description: Precompressed, closed-cell, self-expanding foam. Self stick pressure sensitive adhesive (PSA) on one or two sides as required by substrate conditions
   2. Size: As required for specific joint width and thickness.
   3. Manufacturer: EMSEAL, WILLIAMS PRODUCTS, ILLBRUCK, SCHUL INTERNATIONAL or POLYTITE MANUFACTURING CORP.

PART 3 EXECUTION

3.01 INSPECTION

A. Pre-Installation Meeting
   1. Prior to sealant installation, and at the Contractor's direction, meet at project site to review material selections, joint preparations, installation procedures, weather conditions and coordination with other trades.
   2. Include sealant installer, Contractor, Architect, manufacturer's representative and representatives of other trades or subcontractors affected by the sealant installation.

B. Examine substrates and installation conditions. Do not proceed with joint sealant work until unsatisfactory conditions have been corrected.

C. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 PREPARATION

A. Clean, seal and prime surfaces in accordance with manufacturer's recommendations. Confine primer/sealant to areas of sealant bond.

B. Remove dust, dirt, loose coatings, moisture and other substances which could interfere with sealant bond.

C. Remove lacquers and protective films from metal surfaces.

D. Architectural Concrete and Stone: Apply masking around joints to protect adjacent surfaces from defacement and staining during sealing operations. Repair damaged masking until sealant is installed.

3.03 INSTALLATION

A. Apply joint sealant as late as possible in construction, preceding painting and following cleaning operations. Do not apply sealant during inclement weather conditions or when temperature is above or below manufacturer's limitations for installation.

B. Install joint sealant materials and accessories in strict accordance with manufacturer's installation instructions.
C. Set joint filler units at depth or position in joint as indicated to coordinate with other work. Do not leave voids or gaps between ends of joint filler units.

D. Install sealant backer rod, except where recommended to be omitted by sealant manufacturer for application indicated. Use rod diameter that will cause compression when installed.

E. Install bond breaker tape and where required by manufacturer's recommendations to ensure that sealants will perform as intended.

F. Apply joint sealants in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces on both sides. Fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. At horizontal joints between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt. Hand tool and finish all joints.

G. Install joint sealants within recommended temperature ranges and to depths indicated or when not indicated, as recommended by sealant manufacturer. For normal moving vertical and horizontal joints, fill joints to a depth equal to 50% of joint width, but not more than 1/2” deep nor less than 1/4” deep, measured at the center section of bead.

H. Confine materials to joint areas with masking tapes or other acceptable methods. Remove excess sealant materials promptly as work progresses and clean adjoining surfaces.

I. Masonry Flashing: Where sealant joint is in direct contact with flexible masonry flashing, trim flashing flush with face of masonry after sealant in installed and cured. Verify during this procedure that weep holes have not been compromised during sealing operations.

3.04 CLEANING

A. Upon completion, remove and dispose of masking materials; remove all excess sealing materials; clean adjacent materials of all soil and stain resulting from sealing operations.
   1. Replace damaged material and material which cannot be properly cleaned.

END OF SECTION
PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide expansion joint covers, including all accessories and closures required for a complete installation. Assemblies include, but are not necessarily limited to, the following:
   1. Wall to wall.
   2. Floor to floor.
   3. Wall to floor.

B. Joint covers included in this Section are generally those exposed to view.

C. Coordinate with all trades associated with materials that expansion joint covers are attached to or in contact with; obtain approvals as required; obtain special details required for proper installation of expansion joint covers.

1.02  SUBMITTALS

A. Product Data: Submit manufacturer's catalog cuts and other information showing sizes, materials and finishes.

B. Shop Drawings: Submit typical joint cross-section(s) indicating pertinent dimensioning, general construction, component connections, and anchorage methods.

C. Samples: Submit samples for approval, minimum 6" long, for each type of device proposed. Samples to show all components required for expansion joint cover assembly.

1.03  QUALITY ASSURANCE

A. Manufacturer: Shall have a minimum ten (10) years experience specializing in the design and manufacture of Architectural Expansion Control Systems.

B. Application: The specified expansion control systems shall be installed by a Certified Applicator, factory trained and certified in the proper installation of the specified expansion control system.

C. Floor devices to be watertight.

1.03  PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver products in each manufacturer's original, intact, labeled containers and store under cover in a dry location until installed. Store off the ground, protect from weather and construction activities.
PART 2  PRODUCTS

2.01  ACCEPTABLE MANUFACTURERS

A. Catalog numbers specified below are based on expansion joint covers manufactured by WATSON BOWMAN ACME (WBA). These model numbers are to establish a level of quality. Equal products manufactured by CONSTRUCTION SPECIALTIES, INC. (CSI); BALCO; or MM SYSTEMS CORPORATION are acceptable providing they meet the requirements specified herein and the design intent of the drawings.
3. Floor-to-Floor: WBA FJG 200.
4. Wall-to-Floor: WBA FJG 200C.
5. Other types required but not identified herein by catalog number will be of the same type or series as listed above for similar type application.

2.02  MATERIALS

A. General: Provide extruded 6063-T5 alloy aluminum devices; clear anodized finish for wall and ceiling covers; mill finish for floor covers.

B. Provide models as indicated on drawings.

C. Fasteners
1. Masonry Anchors: Expansion type; length as required to provide minimum 2" embedment into sound masonry.

D. Fire rated: Where required provide ceramic fiber fire barrier backing system designed to provide the required fire rating and cycle tested.
1. Fire rating: As indicated
2. Density: 8 pcf

2.03  FABRICATION

A. General: Fabricate joint cover assemblies as detailed. Provide sealing washers, gaskets, splice covers, and closures as required for complete and secure installations.
1. Fabricate special transitions and corner fittings as required.
2. Miter and weld joints as applicable.
3. Provide necessary and related parts, devices, water barrier, anchors, form clips, and other items required for water-resistant and fire-resistant installations.
4. Provide corners, tees, transitions, curb risers, assembled with connection mitered or interlocking and secured to ensure proper fit and alignment.
5. Special conditions shall be shop fabricated.
6. Floor cover plates shall have surfaces to comply with ADA requirements.
7. Provide components in single lengths where possible; minimize site splicing.
PART 3 EXECUTION

3.01 INSTALLATION

A. General
1. Verify that existing conditions including block-outs are ready to receive expansion joint systems.
2. Beginning the work of this section means acceptance of existing conditions.

B. Install in strict compliance with manufacturer's instructions and recommendations.

C. At existing floor conditions, remove concrete as required and repour to accommodate specified device.

D. Adjust finished height of floor devices for smooth transition with finish flooring materials; verify heights of approved floor finishes before installation of expansion joint covers.
   1. Locate wall and ceiling devices in continuous contact with adjacent surfaces.
   2. Make splices as recommended by manufacturer.
   3. Exposed Butt Joints: Make tight, flush and hairline.

3.02 CLEANING AND PROTECTION

A. Do not remove strippable protective material from joint devices until Architect approves the removal.

B. When Architect permits removal of protective material, remove protective material and clean surfaces in accordance with manufacturer's instructions.

END OF SECTION
SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Standard steel doors and frames.
   2. Fire rated steel doors and frames.
   4. Plumbing chase access doors and frames. Provide rated doors and frames in rated walls.

1.02 RELATED SECTIONS

A. Wood Doors: Section 08 14 00.
B. Door Hardware: Section 08 71 10.

1.03 QUALITY ASSURANCE

A. Provide metal doors and frames fabricated by one manufacturer to ensure uniformity in appearance and construction.

B. Reference Standards: Wherever the following abbreviations are used herein, they shall refer to the corresponding standard:
   3. SDI: Steel Door Institute.
   4. DHI: Door and Hardware Institute.

C. Fire rated doors and frames: Provide units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per ASTM E152, and are labeled and tested by Factory Mutual (FM), Underwriters Laboratories (UL), or other National Recognized testing agency. Units shall bear testing agency labels.
   1. Provide UL labels permanently fastened on each door and frame which is within the size limitations established by NFPA and UL for labeling.
   2. Provide anchors for UL labeled frames required by the authority having jurisdiction.

D. Sound transmission class: Provide certificate that door assemblies have been tested in accordance with ASTM E413 and ASTM E1408 to achieve minimum sound transmission class (STC) specified.

1.04 SUBMITTALS

A. Submit manufacturer's product data and installation instructions for each type of standard metal door and frame required.
B. Submit shop drawings. Identify doors and frames in accordance with drawing door schedule. Indicate:
1. Elevations of each door design.
2. Hardware locations, installation methods and hardware reinforcements.
3. Dimensions and shapes of materials, anchorage and fastening methods.
4. Door frame types, profile of molding and details.
5. Wall opening construction and connection to other work.

C. Certificates documenting:
1. Fire testing: Fire-rated units have been successfully tested in accordance with Paragraph 1.03C.
2. Sound transmission class (STC): Acoustically rated doors have been successfully tested in accordance with Paragraph 1.03D.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver metal doors and frames cartoned or crated for protection during transit and job delivery. Provide sealed wrapping for factory.

B. Store doors and frames inside the building in a dry, well-ventilated area. Protect from damage, wetting and deterioration in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: STEELCRAFT MFG. CO; CECO CORP.; PIONEER INDUSTRIES; REPUBLIC BUILDERS PRODUCTS CORP; CURRIES; AMWELD BUILDING PRODUCTS DIV.

2.02 MATERIALS AND COMPONENTS

A. Materials
1. Metallic-Coated Steel: Commercial quality, hot dipped, A-60 galvannealed steel in accordance with ASTM A653, “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process”.
2. Cold-Rolled Steel: Commercial Steel in accordance with ASTM A1008, “Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy and High Strength with Improved Formability”; Type B; suitable for exposed applications.
3. Hot-Rolled Steel Sheet: Commercial Steel in accordance with ASTM A1011, “Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength”; Type B; free of scale, pitting, or surface defects; pickled and oiled.

B Comply with SDI 100 material and fabrication recommendations and as specified.
C. Standard Metal Doors
   1. Provide flush seamless type doors with seamless faces and edges, 1-3/4" thick, internally reinforced. Top and bottom closed flush.
      a. Provide glass lites where indicated.
   2. Exterior Doors: Provide doors complying with requirements of ANSI 250.8 for Level 3 (extra heavy duty) and Model 2 (seamless design) and ANSI A250.4 for physical endurance Level A.
      a. Fabricated from metallic-coated (galvanized) steel face sheets, mill phosphatized.
      b. 1-1/2 lb. density polyurethane insulated core U-factor 0.09
      c. Tops and bottoms closed with flush galvanized steel caps.
   3. Interior Doors: Provide doors complying with requirements of ANSI 250.8 for Level 3 (extra heavy duty) and Model 2 (seamless design) and ANSI A250.4 for physical endurance Level A.
      a. Fabricated from cold rolled steel; stretcher-leveled standard flatness.
      b. Kraft resin impregnated honeycomb or polystyrene slab core bonded to door face sheets with thermal adhesive.
   4. Hardware Reinforcements: Meet or exceed ANSI/SDI A250.6 requirements.
   5. Edge Profile: 1/8" bevel in 2" core on hinge and lock edges.
   6. Astragals for pairs of doors: Manufacturer’s standard for labeled and non-labeled openings. Factory prepare for hardware as scheduled in Section 08 71 10. Mount astragal to overlap on key side of doors.
   7. Louvers: Inserted fixed type, minimum free area of 38%.
   8. Adjust door widths where full mortise continuous gear hinges are used.

D. Standard Metal Frames
   1. Interior Frames: Fabricated from either commercial grade cold-rolled steel conforming to ASTM A1008 or commercial grade hot-rolled and pickled steel conforming to ASTM A1011, minimum 0.053" thick. Set-up and welded type, all miters clean cut, reinforced, fully seam welded with exposed welds ground smooth.
   2. Exterior Frames: Fabricated from commercial grade metallic --coated (galvanized) steel conforming to ASTM A653, minimum 0.053" thick, and shall have an A-60 zinc coating (0.30 ounces per square foot per side). Set-up and welded type, all miters clean cut, reinforced, fully seam welded with exposed welds ground smooth.
      a. Back prime frames with asphaltic emulsion.
   3. Profile: Double rabbet, jamb face and depth as indicated.
   4. Hardware Reinforcements: Meet SDI 107 requirements.
   5. Transoms and Sidelites: Provide for loose glazing stops to be secured with countersunk screws. Provide ¾” stops for sidelites and transoms where the individual glass areas for fire rated openings exceeds the allowable area for 5/8” stops.

E. Fire Doors and Frames
   1. Comply with Fire-Rated Door Requirements in Paragraph 1.03C.
   3. Classification: As indicated.
   4. Conform to requirements of Standard Metal Door and Frames specified.
F. Frames for Glazed Openings (Borrowed Light): Minimum 0.0516" (18 gage) with integral stop, profile and size per drawings. Provide loose metal glazing stops of same gage as frame.
   1. Provide for loose stops to be secured with countersunk screws. Provide ¾” stops for sidelites and transoms where the individual glass areas for fire rated openings exceeds the allowable area for 5/8” stops.
   2. Verify thickness of glazing material before fabrication and glazing clearances required.
   3. Frame components to be fully welded, except required loose glazing stops, at connections with exposed welds ground flush and smooth with frame surfaces.
   4. Fire Rated Frames: Provide for ratings indicated in accordance with paragraph 2.02D.

2.03 FABRICATION

A. Reinforce and prepare doors and frames to receive hardware. Fit for hardware at the factory to template. Do all necessary cutting, drilling and tapping. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware.

B. Provide surfaces smooth and free from defects, warp or buckle with arrises straight and sharp.

C. Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface applied finish hardware may be done at project site.

D. Locate finish hardware as shown on drawings or, if not shown, in accordance with DHI "Recommended Locations for Builder's Hardware."

E. Door and Frame Fabrication
   1. Provide cutouts for mortised hardware, accurately located and made to fit.
   2. Punch frames for door silencers, three on strike side for single doors. Factory install plastic caps. Stick-on silencers are not acceptable.
   3. Exterior and Interior Frames: Provide minimum three anchors of suitable design for each jamb; galvanized anchors for units built into exterior walls.
   4. Floor Anchors: Provide floor clip on bottom of each jamb. Provide angle spreaders at bottom of each set-up frame.
   5. Conduit for Door Frames
      a. Shop install ¾” electrical conduit within hollow metal door frame where indicated or where required for electric strikes or similar type electrical frame mounted hardware.
      b. Route conduit in frame in the most direct and simple manner so that pulling wire can be performed with a minimum of bends and obstructions. Route conduit to avoid damage to conduit during field installation of frame and operations to grout frame solid.
      c. Connect conduit to electrical junction box or conduit embedded in building structure by means of a threaded coupling. The
termination point of the conduit within the frame shall be free and have enough slack to make final connection to embedded device.

F. Shop Painting
1. Clean, bonderize or chemically treat and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
2. Clean steel surfaces of mill scale, rust oil, grease, dirt and other foreign materials before application of paint. Sand free of imperfections.
3. Apply one baked-on shop coat of rust-inhibitive prime paint in accordance with ASNI A224.1. Provide a smooth, uniformly finished surface ready to receive finish paint.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine substrates, rough openings and installation conditions. Do not proceed with metal door and frame work until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install metal doors and frames in accordance with manufacturer's instructions and recommendations.

B. Placing Frames
1. General
   a. Comply with ANSI/SDI A250.11 (SDI 105) "Recommended Erection Instructions for Steel Frames."
   b. Erect frames in proper position to receive partition work before construction of enclosing walls. Set frames accurately in position, plumbed, aligned with heads level and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders.
   c. Grout frames as indicated on the drawings. Coordinate grout placement with adjoining materials and door hardware.
2. At Masonry Construction: Locate wall anchors at 16" on center. Building-in of anchors and grouting of frames is specified in Section 04 00 00.
3. Fire-Rated Frames: In accordance with NFPA standard No. 80 and SDI 118.
4. Metal Stud Partitions: Install at least 3 wall anchors per jamb at hinge and strike levels. Attach wall anchors to studs with tapping screws.

C. Door Installation
1. Install doors plumb and in true alignment in prepared openings. Fit metal doors accurately in frames, within clearances specified in ANSI/SDI A250.8 (SDI100).
2. Install fire-rated doors with clearances as specified in NFPA Standard No. 80 and SDI 118.

D. Immediately after erection, sand smooth rusted or damaged areas of door and frame coat and apply touch-up prime coat of compatible air-drying primer.

3.03 FIELD QUALITY CONTROL

A. Final Adjustment: Provide final adjustment as follows:
   1. Door Contact with Silencers: Doors shall strike a minimum of two (2) silencers without binding lock or latch bolts in strike plate.
   2. Head, Strike and Hinge Jamb Clearance: 1/8”.
   3. Meeting Edge Clearance, Pairs of Doors: +1/16”
   4. Bolts and Screws: Leave tight and firmly seated.

END OF SECTION
PART 1   GENERAL

1.01  WORK INCLUDED
A. Provide the following types of wood doors: Solid core and Fire rated.

1.02  RELATED SECTIONS
A. Installation: Section 06 20 00.
B. Hollow Metal Door Frames: Section 08 11 13.
C. Door Hardware Section 08 71 10.

1.03  QUALITY ASSURANCE
A. Provide wood doors fabricated by one manufacturer to ensure uniformity in appearance and construction.
B. Reference Standards
1. Underwriters' Laboratories - UL 10C (positive pressure) - Fire Tests of Door Assemblies
2. Window and Door Manufacturers Association (WDMA): WDMA IS 1A-04.
4. NFPA 80 - Fire Doors and Windows
5. NFPA 252 - Standard Methods of Fire Tests for Door Assemblies
C. Engineered Wood Products
1. Determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
2. Determine Volatile Organic Compounds (VOC), excluding formaldehyde, emitted from manufactured wood-based panels per ASTM D6330.

1.04  SUBMITTALS
A. Submit manufacturer's product data and installation instructions for each type of wood door required.
1. Include details of core and edge construction.
2. Include certification indicating compliance with specification requirements.
B. Submit Shop Drawings
1. Indicate location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking and other pertinent data.
2. Identify doors in accordance with drawing door schedule.
C. Submit sample corner section, 12" square, showing required veneer and edge construction.

D. Finish Samples
1. Factory Finished Doors: Submit three (3) flitch samples of each species of face veneer with factory applied stain and finish as specified and indicated illustrating expected range of color and grain variation.
2. Field Finished Doors: Submit three (3) flitch samples of each species of face veneer as specified and indicated illustrating expected range of grain variation. Samples will be used to select and approve field stain color as specified in Section 09 91 00.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store and protect doors in accordance with manufacturer's recommendations and WDMA.

B. Following are general guidelines. For more specific information refer to WDMA's Appendix Section “Care and Installation at Job Site.”
   1. Deliver doors in manufacturer's original unopened protective packaging or wrapper.
      a. Store doors flat and off the floor on a level surface in a dry, well-ventilated building. Do not store on edge. Protect doors from dirt, water and abuse.
      b. Do not subject interior doors to extremes in either heat or humidity. HVAC systems should be operational and balanced, providing a temperature range of 50 to 90 degrees Fahrenheit and 30% to 50% relative humidity.
      c. When handling doors, always lift and carry. Do not drag across other doors or surfaces. Handle with clean hands or gloves.
      d. Each door will be marked on top rail with opening number.

1.06 LABEL DOOR REQUIREMENTS

A. Fire Ratings Compliance: Comply with the label requirements of NFPA and applicable local codes. Fabricate doors and frames in accordance with requirements of NFPA Standard No. 80 and U.L. Standards as follows:
   1. Neutral Pressure Testing - UBC 43-2 or 7-2-94; or UL10B.
   2. Positive Pressure Testing UBC 7-2-97 or UL10C

B. Ratings Certifications
   1. Provide U.L. labels permanently fastened on each door that is within the size limitations established by NFPA and U.L. for labeling.
   2. Provide anchors for U.L. labeled frames required by the authority having jurisdiction.

1.07 WARRANTY

A. Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
a. Warping (bow, cup, or twist) more than 1/4 inch in a 42 x 84 inch section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty Period for Solid-Core Exterior Doors: Two years from date of Substantial Completion.

**PART 2 PRODUCTS**

2.01 MATERIALS AND COMPONENTS

A. Interior Flush Doors Solid Core: Meet or exceed WDMA I.S.1A Industry Standard for Wood Flush Doors requirements and as specified. WDMA I.S.1A. Performance Grade – Extra Heavy Duty.

1. Interior Flush Doors Solid Core – Non-Rated and 20 Minute Rated Fire Doors: Provide one of the following cores with hardwood veneers:
   a. Stave Lumber Core (SLC-5) may be a combination of solid, low-density hardwood lumber blocks or strips not more than 2-1/2" wide of one species of wood between 6% to 9% moisture content. Joints to be tight and staggered in adjacent rows. Lumber density is 25 to 27 lbs. per cubic foot. Formaldehyde free.
   b. Structural Composite Lumber Core (SCLC-5) is an engineered hardwood composite sometimes referred to as LSL (Laminated Strand Lumber). The material complies with WDMA minimum performance levels for interior applications with screw holding power of 540 lbs., modulus of rupture of 6,500 psi, modulus of elasticity of 1,300,000 psi and density of 38 lbs per cubic foot. Formaldehyde free.

2. Interior Flush Fire Doors – Above 20 Minute Rated: FD solid core with hardwood face veneer.
   a. Rating as indicated on drawings.
   b. Provide one of the above cores or the following as required to maintain fire rating:
      1) Non-combustible mineral composite material that is necessary for higher hourly ratings per manufacturer’s approval.

B. Moldings: Trim louver and glass openings with recessed bead type wood moldings, species matching door face veneer species. Profiles as selected by the Architect from manufacturer’s standard profiles.

1. Glass Lites in Fire Rated Doors: Manufacturer’s standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips required for opening size and fire rating indicated.

2.02  FABRICATION

A.  Flush Doors:  Fabricate doors in accordance with WDMA I.S. 1A, "Premium Grade" requirements for transparent stained finish.  Formaldehyde free.
   1.  Core Construction: Bond stiles and rails to core and sand entire unit prior to assembly of face veneers.
   2.  Number of Plies: 5.
   3.  Face Veneers: Minimum 1/50" thick before sanding, plain sliced white oak.
   5.  Adhesive: Type I, waterproof.
   6.  Edge Strips: Stile edges hardwood species matching face veneer; bonded to core; 1-1/8" minimum width after trimming.  Top and bottom edges hardwood of mill option.
   7.  Match Between Veneer Leaves: Book matched for color and grain.
   8.  Assembly of Veneer Leaves on Door Faces: Running match.
   9.  Hardware: Factory machine for mortise hardware using template provided by hardware manufacturer.
  10.  Reinforcement: Reinforce doors to receive hardware specified.
       a.  Hinge Attachment: Stiles and rails to be continuously glue bonded to the core so that screw stress is transmitted directly to the core.
       b.  Closure, Exit Device and Other Surface Mounted Hardware: Provide top rail 2-1/2" or more in width to hold closer fasteners and solid wood blocking for all other surface applied hardware.

B. Fire Rated Doors: Conform to "Flush Door" requirements specified above.  Provide doors of U.L. classification indicated.
   1.  Reinforcement: Reinforce doors to receive hardware specified.
       a.  Surface applied hardware located where screws cannot penetrate the above mentioned stiles or wood rails shall be through bolted.

C. Factory Finish
   1.  Comply with recommendations of WDMA for factory finish of doors utilizing manufacturer's standard stain and clear top finishing system similar:
       a.  Filler/Stain: Color as selected by Architect.
       b.  Clear sealer.
       c.  Clear topcoat.
       d.  Sanding.
       e.  Clear topcoat.
       f.  Packaging.

D. Individually package doors at factory with manufacturer's standard packaging or wrapping for delivery to job site.

E. Manufacturer: MARSHFIELD DOOR SYSTEMS; EGGERS; ALGOMA; OSHKOSH; V T INDUSTRIES, LAMBTON DOORS.

PART 3  EXECUTION

3.01  INSPECTION
A. Examine substances, rough openings and installation conditions. Do not proceed with wood door installation until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 PREPARATION

A. Verify metal frame dimensions and hardware mortises in metal frames with metal frame manufacturer.

3.03 INSTALLATION

A. Condition doors to average prevailing humidity in installation area before hanging.

B. Install doors in accordance with manufacturer’s installation instructions. Job fit and prepare doors to receive hardware. Bevel 1/8" in 2" at strike edges for clearance in arc of swing. Seal cut surfaces, tops, bottoms and edges with sanding sealer after fitting and machining.

C. Hang doors straight, plumb and square securely anchored into position. Adjust doors to provide uniform clearance and to contact stops uniformly. Remove and replace doors that are warped, bowed or otherwise damaged and cannot be properly fit to the opening.

D. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA No. 80.

3.04 PROTECTION

A. Protect installed doors from soiling, staining and damage until final acceptance.

B. Repair or replace doors damaged beyond acceptable repair as directed by the Architect.

END OF SECTION
SECTION 08 31 13
ACCESS DOORS

PART 1 GENERAL

1.01 WORK INCLUDED
A. Provide wall, partition and ceiling access doors for access to mechanical and electrical equipment as indicated. Provide fire-rated where indicated or specified.

1.02 RELATED SECTIONS
A. Finish Painting: Section 09 91 00.
B. MPE systems requiring access: Divisions 21 thru 28.

1.03 QUALITY ASSURANCE
A. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access panels. Coordinate delivery with other work to avoid delay.

1.04 SUBMITTALS
A. Submit product data and shop drawings for each item. Include installation instructions for conditions involved.

PART 2 PRODUCTS

2.01 MATERIALS AND FABRICATION - WALL AND CEILING TYPES
A. General: Provide access panel assembly manufactured as an integral unit, complete with all parts and ready for installation. Fabricate units of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

B. Standard Access Door
1. Description: Minimum 14 gage steel panels with minimum 16 gage steel frames. Units to have concealed hinges.
2. Provide with exposed 1” frame flange.
3. Manufacturer: Provide panels by one of the following, subject to the above requirements.
   a. J. L. INDUSTRIES INC. Model TM
   b. LARSEN’S MANUFACTURING Model L-MPG
   c. BABCOCK-DAVIS Model B-NT
C. Fire-Rated Access Door
   1. Description: Minimum 20 gage interior and exterior steel panels with
      minimum 16 gage steel frames and masonry wall type anchors welded to
      frame.
      a. Automatic Closing: Provide self-closing spring device to assure
         positive latching.
      b. Fire-Rating: U.L. label equal to wall rating indicated on drawing.
      c. Provide interior lock/latch release device.
      d. Core: Fire-rated mineral fiber.
   2. Manufacturer: Provide panels by one of the following, subject to the above
      requirements.
      a. J. L. INDUSTRIES INC. Model FD
      b. LARSEN’S MANUFACTURING Model L-FRAP
      c. BABCOCK-DAVIS Model B-IT

D. Locks: Provide cylinder locks on all access doors. Provide 2 keys per access door. Key all access doors alike.

E. Finish: Factory Prime Finish. Apply manufacturer's standard, fast-curing, lead-
and chromate-free, universal primer immediately after surface preparation and
pretreatment.

**PART 3 EXECUTION**

3.01 INSPECTION

   A. Installer must examine areas and conditions under which access panels are to be
      installed and must notify General Contractor, in writing, of conditions detrimental to
      proper and timely completion of work. Do not proceed with work until
      unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

   A. Comply with manufacturer's instructions for installation of access panels.

   B. Coordinate installation with work of other trades.

   C. Set frames accurately in position and securely anchor to supports with face panels
      level in relation to adjacent finish surfaces.

3.03 ADJUST AND CLEAN

   A. Adjust hardware and panels after installation for proper operation.

   B. Remove and replace panels or frames that are warped, bowed or otherwise
      damaged.

**END OF SECTION**
SECTION 08 41 13
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work under this section includes the design of the aluminum entrance and window systems and all materials, labor and equipment for the complete installation of the work as shown on the drawings and specified herein. Work includes:
1. Aluminum entrance doors and storefront system.
2. Aluminum entrance framing system for entrances and vestibule, including sidelight and transom frames as indicated.
3. Fixed Aluminum Windows.
4. Glass and glazing and hardware of the systems.
5. Anchors, fasteners, flashings, trim and accessories to complete the work.
6. Sealants required within entrance and window construction.
7. All gaskets, sealants and tapes required in final assembly of the work.
8. Installation of lock cylinders furnished under Section 08 71 10.

1.02 RELATED SECTIONS

A. Joint Sealants: Section 07 92 00.
B. Glazed Aluminum Curtainwalls: Section 08 44 13
C. Hardware: Section 08 71 10.
D. Glazing: Section 08 81 00.
E. Vapor/Air Barrier Transition Membranes: Section 07 27 26.

1.03 QUALITY ASSURANCE

A. Provide aluminum doors and framing system manufactured by a single firm specializing in the production of this type of work.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Painted Finishes: Factory painted finish to be performed by an applicator approved by the paint manufacturer. The applicator shall provide written notification of approval by paint manufacturer prior to application of the finish.

1.04 REFERENCES

Performing High Performance Organic Coatings on Architectural Extrusions and Panels, AAMA 2605.

1.05 SUBMITTALS

A. Submit the following in accordance with the General Conditions:
   1. Framing system details.
   2. Door and Window details.
   3. Installation instructions.
   4. Itemized schedule of door hardware.
   5. Finish samples showing the light and dark range limits of the anodizing colors. These finish samples will be used in the field as a check for items specified in this section. Anodized items whose color does not fall within the range indicated by these samples are unacceptable and shall not be used in the finished work.

B. Tests: Submit two copies of test reports made or witnessed by an independent testing laboratory showing the results of tests conducted on previously manufactured windows of the type used on this project. The reports shall verify conformance to thermal movement, air and water infiltration and structural properties as described herein.

C. Building Shop Drawings: Include complete evaluations of all systems; details and methods of anchorage; details of construction finishes; methods of assembly; location and installation of hardware and reinforcement for same; size, shape and thickness of materials; joints and connections; details of joining with other work.
   1. Scale: Include typical unit elevation of each system at 1/2" scale and details at full scale where practical.

D. Product Data: Submit manufacturer's specifications for materials and fabrication of work, and instructions and recommendations for installation and maintenance. Include certified test reports showing compliance with requirements where a test method is indicated.

E. Samples: Submit samples of each type and color and finish required by this Section, on 12" sections of extrusions or formed shapes and on 6" squares of sheet/plate. Include two or more samples in each set. Architect reserves right to require fabrication samples showing prime members, joinery, anchorage, expansion provisions, glazing and similar details, profiles and intersections.

1.06 DELIVERY, STORAGE AND HANDLING

A. Pack, deliver, handle, store and protect materials from damage in accordance with AAMA Curtain Wall #10, "Care and Handling of Architectural Aluminum" recommendations.
   1. Remove paper type wrappings when unloading.
   2. Store materials inside the buildings whenever possible in clean, dry ventilated areas free of dust or corrosive fumes.
   3. Stack members vertically or on edge, shim between components to provide water drainage and ventilation. Protect with adequate coverings, placed to provide adequate air circulation.
4. During installation, protect materials from lime mortar, concrete and copper run-off, weld splatter, acids, roofing materials, solvents, abrasive cleaner.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.08 WARRANTIES

A. Submit written warranty signed by manufacturer, Contractor, and installer agreeing to repair or replace work which fails in materials or workmanship within three years of the date of project acceptance. Failure of materials or workmanship shall include excessive leakage or air infiltration, excessive deflections and defects in accessories, weather seals and other components of work.

B. Finish: Provide paint manufacturer's guarantee of paint finish against failure of paint finish. Failure includes blistering, peeling, cracking, flaking, checking, excessive color change and chalking. Color change shall not exceed 5 N.B.S. units (per ASTM D523) and chalking shall not less than a rating of 8 per ASTM D4214.

1. Warranty Period: 15 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Drawings and specifications are based on products by KAWNEER CO.

B. Other Acceptable Manufacturers: Equal products by the following manufacturers are acceptable providing they meet or exceed the requirements specified herein and conform to the design intent indicated on the drawings:

1. CRL – U.S. ALUMINUM
2. EFCO
3. OLDCASTLE BUILDING ENVELOPE
4. TUBELITE DIVISION, INDAL, INC.
5. VISTAWALL

2.02 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after
surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36.
2. Cold-Rolled Sheet and Strip: ASTM A 1008.

2.03 STOREFRONT, WINDOW FRAMING AND ENTRANCE DOOR SYSTEMS

A. Type: An integrated system of extruded aluminum sections, glazing devices, sealing devices, doors and hardware and fixed windows.

B. Materials: Provide aluminum alloy and temper for each shape as recommended by manufacturer and processor to comply with requirements of performance, fabrication, and application of finish.

1. Thickness: As required to meet design requirements with a minimum of 1/8" for major sections.
2. Material and products to be manufactured regionally AND harvested, extracted, or recovered regionally within a radius of 500 miles from the project site. Minimum 25% recycled content.

C. Framing: KAWNEER 451T, framing for 1” insulating glass.

1. Type: Thermally broken, outside glazed, fixed type framing as indicated.
2. Frame
   a. Members: Main frame members designated specifically for manufacture of aluminum windows extruded from 6063-T5 aluminum alloy.
   b. Glazing: Extruded snap-in type bead; to accept 1” insulating glass
   c. Trim: Provide trim, sills, flashings, closures to complete installation.
   d. Size
      1) Sightline: Nominal 2”.
      2) Depth: 4-1/2”.
3. Glazing Plane: Center, unless otherwise indicated.
4. Special Framing Shapes: Provide as detailed or as required to maintain design intent as indicated on building elevations drawings and section drawings. Aluminum extruded shapes and bent aluminum sheet, minimum 0.063”, finished after fabrication.
5. Vestibule Framing: KAWNEER Trifab II 451. Units to accept 1/4” glass.

D. Performance Requirements: Exterior window wall system (excluding doors) shall meet or exceed the following performance requirements.

1. Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures indicated on the drawings.
2. Thermal Movement: Window framing system shall be designed to provide for expansion and contraction of component materials caused by a surface temperature range of 180°F., without causing buckling, stresses on glass, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects.
3. Air Infiltration: Air leakage shall not exceed 0.06 cfm per square foot of fixed wall area when tested in accordance; with ASTM E283 at test pressure not less than 6.24 psf.
4. Water Infiltration  
   a. Provide drainage to exterior face of framing water entering at joints.
   b. No uncontrolled water penetration shall occur when tested in accordance with ASTM E331, at test pressure not less than 8.0 psf.

5. Structural Properties - Uniform Load: A static air design load of 20 psf shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

6. Thermal Properties  
   a. Thermal transmittance due to conduction (Uc) shall not be greater than 0.58 BTU/hr/ft sq./degree F when tested in accordance with AAMA 1503.1.
   b. Condensation Resistance Factor Frame (CRF): Shall not be less than 61 when tested in accordance with AAMA 1502.7.

E. Glazed Aluminum Entrance Doors: Medium stile, manufacturer's standard, single acting aluminum entrances.
   1. Stiles: Nominal 3-1/2" wide.
   2. Rails  
      a. Top: 3-1/2" high.
      b. Bottom: 10" high.
   3. Section Wall Thickness: .125" (major components); 0.05" (glazing moldings)
   4. Door Thickness: 1-3/4".
   5. Corners: Stiles through design, joined by concealed bolts and weld.
   6. Provide complete with snap-in glazing stops and gaskets.
   7. Sizes: As indicated. Provide single or pairs of doors as scheduled.
   8. Exterior Entrance Weatherstripping: KAWNEER "Sealair Weathering" system or equal by other approved manufacturer. Locate weatherstripping at jambs, head and meeting stiles (as applicable). Provide bottom rail with EPDM blade gasket sweep. Size sweep to close against door threshold. Sweep housing finish to match door finish.

2.04 FINISHES  
   A. Exposed aluminum surfaces shall receive an Architectural Class 1, clear anodized coating; AA-M12C22A41, minimum 0.7 mil thickness.
      1. Color: As selected from paint manufacturer's complete specified line.
      3. Concealed members may be mill finished, providing they cannot be seen through the glass.

2.05 ENTRANCE DOOR HARDWARE  
   A. Prepare and reinforce doors and frames for hardware. Factory fit and install hardware in accordance with Section 08 71 00 and manufacturer's requirements.
B. Hardware
1. Offset Pivots: Provide top, intermediate and bottom pivots. Baked-on epoxy finish to match finish of door.
2. Closers: LCN 4041 CUSH each leaf. Spray painted to approximate framing finish.
3. Exit Device: VON DUPRIN Series 99 for wide stile doors and Series 33 for narrow and medium stile doors. Concealed vertical rod for both leaves of pairs of doors and rim device for single doors. Devices shall include the following as applicable: panic device, crash bar, vertical rods, top and bottom latch housings, roller strike, and lock mechanism. Cylinder shall be furnished and keyed in accordance with Section 08 71 00. Cylinder finish shall match exit device.
   a. Provide exit device with finish to match framing.
   b. Trim: Provide 9947TP and 9947DT for all pairs of doors; and 99TP trim for all single doors.
4. Threshold: Extruded aluminum, natural anodized finish, maximum 1/2" high, provide on all exterior doors. Provide stainless steel fasteners.

2.06 ACCESSORIES

A. Fasteners: Aluminum, non-magnetic stainless steel or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum components. Finish exposed fasteners to match aluminum work.

B. Flashing, Trim and Accessories: Provide as required to complete the work. Finish shall match aluminum entrances and storefront finishes. Work includes:
   1. Aluminum closure panels, flashing and trim.
   2. Concealed Flashing: Dead-soft stainless steel, 26 gauge minimum, type selected by manufacturer for compatibility.
   3. All trim materials shall be finished after fabrication, unfinished exposed edges at holes and trim terminations are not acceptable.

C. Brackets and Reinforcements: Manufacturer's high strength aluminum units where feasible; otherwise, nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A123. Reinforce doors to receive hardware.

D. Bituminous Coatings: Cold applied asphalt mastic complying with SSPC PS 12, compounded for 30 mil thickness per coat.

E. Structural Sealant: Designed to carry gravity loads of glazing and capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed storefront/strip windows without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
   1. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront/strip windows assembly indicated. Color: As selected by Architect from manufacturer's full range of colors.
2.07 FABRICATION

A. Provide manufacturer's standard fabrication and accessories that comply with indicated requirements. Minor dimension differences will be accepted in order to utilize manufacturer's standard products.

B. Fit and assemble the work at the shop to the greatest extent possible. Disassemble only as required for shipment and erection. Maintain true continuity of line and accurate relation of planes and angles. Provide secure attachment and support at mechanical joints, with hairline fit of contacting members. Conceal fasteners wherever possible.

C. Reinforce aluminum work as necessary at points of support or anchorage and at mechanical joints and points of attachment to meet performance requirements and for support of the system. Separate dissimilar metals with bituminous paint or preformed separators that will prevent corrosion. Separate metal surfaces at moving joints with plastic inserts or other non-abrasive concealed inserts.

D. Coordinate work of this section with other work for proper sequence of construction without delays. Verify dimensions of supporting structure and other elements that precede wall system work before fabrication of required components. Provide for erection tolerances for other work where field measurements cannot be obtained.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine substrates supporting structure, and installation conditions. Do not proceed with aluminum entrances erection until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. General
1. Do not install component parts that are observed to be defective, including warped, bowed, dented, abraded and broken members.
2. Remove and replace members that have been damaged during installation or thereafter before time of acceptance.
3. Do not cut or trim component parts during erection, in a manner which would damage finish, decrease strength or result in a visual imperfection or a failure in performance of the work.

B. Install components in accordance with the manufacturer's installation instructions and recommendations.

C. Install component parts level, plumb, true to line and with uniform joints and reveals. Secure to structure with non-staining and non-corrosive shims, anchors,
fasteners, spacers and fillers.

D. Assembly and Anchorage: Anchor component parts securely in place, by bolting or other permanent mechanical attachment system, which will comply with performance requirements and permits movements as required.

E. Apply a bituminous coating or other suitable separator on concealed contact surfaces of dissimilar materials, before assembly or installation to prevent corrosive or electrolytic action.

F. Set sill members and entrance thresholds in a bed of sealant compound, or with joint fillers or gaskets to provide weathertight requirements.

G. Install glass and glazing, in accordance with Section 08 81 00 and the manufacturer's requirements.

H. Install joint sealants specified in Section 07 92 00, in accordance with the manufacturer's requirements.

I. Adjust operating hardware to function properly, without binding, and to provide tight proper fit at contact points and weatherstripping.

3.03 CLEANING AND PROTECTION

A. Protect glass from breakage immediately upon installation, by attachment of streamers to framing held away from glass. Do not apply markings of any type to surfaces of glass.

B. Remove protective coating when completion of construction activities no longer require its retention.

C. Immediately before acceptance of the work, clean the aluminum entrance systems thoroughly, inside and out. Demonstrate proper cleaning methods to Owner's maintenance personnel during final cleaning. Prepare a "Cleaning and Maintenance Manual" listing types of cleaning compounds, cleaning methods, sealants and glazing materials used for cleaning, repair and maintenance of work and turn over to Owner upon acceptance of the work.

END OF SECTION
PART 1  GENERAL

1.01  WORK INCLUDED

A. Work under this section includes the design and engineering of the curtain wall system and all materials, labor and equipment for the complete installation of the aluminum curtain wall system as shown on the drawings and specified herein. Work includes:
   1. Aluminum curtain wall framing.
   2. Glass and glazing of the aluminum curtain wall system and entrance doors.
   3. Anchors, fasteners, flashings, trim and accessories to complete the work.
   4. Sun shade; mounted to vertical mullions.
   5. Aluminum faced/insulated glazing panels.

B. Provide reinforcing within curtain wall framing as required to meet design loads and span conditions.

[C. Coordination and scheduling of [Owner’s] field performance tests.]

1.02  RELATED SECTIONS


B. Sustainable Design Requirements: Section 01 81 13.

C. Joint Sealants: Section 07 92 00.

D. Glass and Glazing: Section 08 81 00.

E. Aluminum Entrance doors: Section 08 41 13.

[F. Fluoropolymer Metal Coatings: Section 05 05 13.]

G. Spandrel Insulation: Section 07 21 00.

H. Vapor/Air Barrier Transition Membranes: Section 07 27 26.

1.03  QUALITY ASSURANCE

A. Provide standard aluminum curtain wall framing system and aluminum doors manufactured by firms specializing in the production of this type of work that conforms to project requirements.

B. Painted Finishes: Factory painted finish to be performed by an applicator specifically approved by the paint manufacturer. The applicator shall provide written confirmation of approval by paint manufacturer prior to application of the finish.
C. Coordination: Coordinate entrance doors, frames and subframes that are indicated to operate within curtain wall system. Include:
1. Aluminum finish systems. Colors selected must be an exact color match to aluminum entrance system finish, as determined by the Architect, from the same paint system manufacturer.
2. Door hardware.

D. Mockups: Build in-place, on-building mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups of typical curtainwall area and punched openings as shown on Drawings.
2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

E. Field Testing Laboratory: Provide testing lab services in accordance with Section 01 40 00.

1.04 REFERENCES

1.05 SUBMITTALS
A. Submit the following:
1. Framing system details.
2. Installation instructions.
3. Finish samples.

[3. Finish samples showing the light and dark range limits of the anodizing colors. These finish samples will be used in the field as a check for items specified in this section. Anodized items whose color does not fall within the range indicated by these samples are unacceptable and shall not be used in the finished work.]

B. Tests: Submit two copies of test reports made or witnessed by an independent testing laboratory showing the results of tests conducted on previously manufactured windows of the type used on this project. The reports shall verify conformance to thermal movement, air and water infiltration and structural properties as described herein.

C. Building Shop Drawings: Include complete evaluations of all systems; details and methods of anchorage; details of construction finishes; methods of assembly; location and installation of hardware and reinforcement for same; size, shape and thickness of materials; joints and connections; details of joining with other work.
1. Scale: Include typical unit elevation of each system at 1/2" scale and details at full scale where practical.
2. Calculations: Show full derivation of loads and successful resolution of loads on individual members, their connections, and fasteners to the connection to the building, showing conformance to specified criterion. Such calculations shall be done by a structural engineer licensed to practice in the State of Tennessee. Calculation submission must coincide with shop drawing submission.

D. Product Data: Submit manufacturer’s specifications for materials and fabrication of work, and instructions/recommendations for installation and maintenance. Include a summary cover listing conformance to project conditions.

E. Samples: Submit samples of each type and color and finish required by this Section, on 12” sections of extrusions or formed shapes and on 6” squares of sheet/plate. Include two or more samples in each set.
   1. Architect reserves right to require fabrication samples showing prime members, joinery, anchorage, expansion provisions, glazing and similar details, profiles and intersections.

F. Special Environmental Requirements: Submit the following in accordance with Section 01 81 13:
   1. Recycled Content
      a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
      b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
      c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
      d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.
   2. Local/Regional Materials
      a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
      b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
      c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
      d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

G. Field Performance Tests: Submit copies of field performance test reports specified in Article 3.03 herein. See Section 01 40 00.

1.06 DELIVERY, STORAGE AND HANDLING

A. Pack, deliver, handle, store and protect materials from damage in accordance with AAMA Curtain Wall #10, “Care and Handling of Architectural Aluminum” recommendations.
1. Remove paper type wrappings when unloading.
2. Store materials inside the buildings whenever possible in clean, dry, ventilated areas, free of dust or corrosive fumes.
3. Stack members vertically or on edge, shim between components to provide water drainage and ventilation. Protect with adequate coverings, placed to provide adequate air circulation.
4. During installation, protect materials from all construction materials, including mortar, concrete, weld splatter, cleaning acids, roofing materials, solvents, abrasive cleaners and runoff from all the above.

1.07 PERFORMANCE REQUIREMENTS – CURTAINWALL

A. Performance Requirements: Exterior curtain wall system shall have been tested to meet or exceed the following performance requirements.

1. Wind loads: Provide curtain wall system; including glazing, panels and anchorage, capable of withstanding wind load design pressures derived from criteria indicated.

2. Air Infiltration: Air leakage shall not exceed 0.06 cfm per square foot of fixed wall area and 0.1 cfm for each lineal foot of crack of operable elements when when tested in accordance; with ASTM E283 at test pressure not less than 6.24 psi.

3. Water Infiltration
   a. Provide drainage to exterior face of framing any water entering at joints and any condensation occurring within window construction.
   b. Static Pressure: No uncontrolled water penetration when subjected to water spray at the rate of five gallons per hour per square foot at a static pressure of 10 psf for 15 minutes when tested in accordance with ASTM E331.
   c. Dynamic Pressure: No uncontrolled water penetration when subjected to water spray at the rate of five gallons per hour per square foot with wind from an aircraft engine generating a pressure of 10 psf for 15 minutes; tested in accordance with AAMA TM-1 and AAMA 501.1.

4. Structural Properties: No damage or failure shall occur when tested in accordance with ASTM E330. Standard test design loading shall be minimum 20 psf, positive and negative windload. A design deflection criteria of L/175 or 3/4" maximum for spans up to 13'-4", and L/240+1/4 inch for spans over 13'-4" shall apply to both positive and negative loads. At structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans or 1/16" at members shall occur.

5. Average Thermal Conductance: Provide glazed aluminum curtain-wall systems with average U-factor of not more than [0.35] Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

6. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor for the frame shall not be less than [79] using low e glass (90 % argon fill with warm edge spacer).

7. Thermal Requirements: Framing system designs to accommodate expansion and contraction movement due to surface temperature differential of 180°F without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance or other detrimental effects.
1.08 WARRANTIES

A. Furnish written guarantee certifying that all work furnished and installed will be free of defects in materials and workmanship, and remain watertight for a period of three (3) years from date of Substantial Completion. Should any defect develop during the guaranty period due to faulty materials or improper workmanship, such defects will be repaired or replaced with new work at no expense to the Owner.

B. Provide 20 year manufacturer's guarantee of paint finish against failure of paint finish from paint manufacturer. Failure includes blistering, peeling, cracking, flaking, checking, excessive color change and chalking. Color change shall not exceed 5 N.B.S. units (per ASTM D523) and chalking shall not less than a rating of 8 per ASTM D4214.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Drawings and Specifications are based on 1600 Series manufactured by KAWNEER.

B. Other Manufacturers: Systems manufactured by the following are acceptable providing they meet the performance and dimensional requirements that are specified herein and conform to the design intent indicated on the drawings.
   1. CRL – U.S. ALUMINUM
   2. EFCO
   3. OLDCASTLE BUILDING ENVELOPE
   4. TUBELITE DIVISION, INDAL, INC.
   5. WAUSAU

2.02 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.

[B. Minimum 25% recycled content.

C. Material and products to be extruded and manufactured regionally within a radius of 500 miles from the project site.]

2.03 CURTAIN WALL SYSTEM

A. Aluminum Framing Members: Alloys best suited to meet the performance requirements and structural characteristics as published by the Aluminum Association. Other alloys will be considered only if published literature is available by the primary producer of the material and justified by both the manufacturer and structural engineer for the curtainwall. Provide thicknesses, shapes and profiles as required to comply with performance requirements.
1. Shapes: extruded horizontal and tubular vertical framing sections; anchor mullions at framing structure as indicated. 0.125” inch thick minimum for primary structural members.

[2. Special (Custom) Framing Shapes: Provide as detailed or as required to maintain design intent as indicated on building elevations drawings and section drawings. Aluminum extruded shapes and bent aluminum sheet, minimum 0.063”, unless indicated otherwise. [Custom shapes include:]

a. Sloped Curtainwall: Horizontal mullion glazing retainer cover cap at curtainwall outside corner.
b. Extended horizontal mullion glazing retainer cover cap.]

B. Size: [3”] [2-1/2”] wide x depths [indicated.] [required for design loads.]

C. Design system for exterior glazing of vision lites.

D. Anchorage: Provide anchorage to building structure for three directional adjustments for fabrication and construction tolerances. All connections must be bolted; screws are not permitted.

F. Trim and Closures: Visible aluminum trim and closures that are not extruded, shall be fabricated from .125” thick aluminum plate finished to match other aluminum curtain wall materials, unless noted otherwise on the drawings. Provide concealed fasteners wherever possible.

2.04 ALUMINUM DOORS AND SUBFRAMES

A. Type: A system of extruded aluminum subframe sections, sealing devices, and doors and hardware integrated into the curtainwall system.

1. Provide subframe and doors compatible with aluminum curtain wall system.
2. See Section 08 41 13.

2.04 ALUMINUM DOORS

A. Glazed Aluminum Entrance Doors: [Wide] style, flush glazed, single acting, aluminum entrances.

1. Sizes: As indicated. Provide single or pairs of doors as scheduled.
2. Exterior Entrance Weatherstripping: KAWNEER "Sealair Weathering" system or equal by other approved manufacturer.
3. Glazing: 1/4”.
4. Section Wall Thickness: [.188”] [.125”] for major components; 0.05” for glazing moldings.
5. Corners: Stiles through design, joined by concealed through-bolts and fully welded.
6. Provide complete with snap-in glazing stops and gaskets.
7. Bottom Rail: 10”.

B. Framing: Provide supplemental framing required for use in curtain wall framing.

2.05 ACCESSORIES
A. Fasteners: 300 Series stainless steel for system joinery, zinc-plated for bolt anchors if occurring interior of system’s water barrier. No exposed fasteners without Architect’s permission. If exposed, finish exposed fasteners to match aluminum work.

B. Sill Pan Flashing: Dead-soft stainless steel, 26 gauge minimum, type selected by manufacturer for compatibility.

C. Brackets and Reinforcements: Manufacturer’s high strength aluminum units where feasible; otherwise, nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A386.

D. Sun Shade: An aluminum sunshade (consisting of custom outriggers, louvers, and fascia) that is anchored directly to the vertical curtain wall mullions. Minimum 20% recycled content.

1. Design, Size and Profiles: Design and fabricate sunshades to outside dimensions indicated and profiles indicated. Provide gages and sizes of materials as required for span and load conditions.
   a. 45 PSF ground snow load
   b. 25 PSF wind load
   c. 3'-2" mullion spacing

2. Manufacturer/Model: 1600 Sunshade by KAWNEER or equal by curtainwall manufacturers listed in paragraph 2.01G.

E. Separate dissimilar materials and metals with full face plastic shims or similar type materials.

F. Slip Joint Linings: Provide plastic sheets, spacers or bearing pads to ensure free movement between surfaces where expansion and deflection movements are intended. Provide units of sizes and thicknesses as recommended by manufacturer.

G. Aluminum Faced Glazing Panels: Provide panels where indicated consisting of rigid extruded polystyrene or polyurethane insulation core (minimum 2.0 pcf) with laminated .032 aluminum facing sheets. Provide with fluoropolymer finish (70% Kynar) finish; color as selected by Architect to match anodized curtainwall framing members.

H. Structural Sealant: Designed to carry gravity loads of glazing and capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

   1. Structural Glazing Sealants: ASTM C1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.
      a. Color: As selected by Architect from manufacturer's full range of colors.
2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

I. Back-Pans: Minimum 0.040 inch painted aluminum back-pan where exposed, and 20 gauge galvanized steel where not exposed, with stiffeners as required.
   1. Finish: Where exposed, provide finish color to match framing as approved by Architect.

2.05 FABRICATION

A. Comply with dimensions and profiles indicated on drawings.

B. Provide manufacturer's standard fabrication and accessories that comply with indicated requirements. Minor dimension differences will be accepted in order to utilize manufacturer's standard products.

C. Thermal Break Construction: Fabricate curtain wall framing with a concealed low conductance thermal barrier, located in a manner which eliminates direct metal-to-metal contact. Provide manufacturer's standard construction that has been tested to demonstrate resistance to thermal conductance and condensation as specified, and has been tested to resist specified loads and differential movement.

D. Shop fabricate aluminum curtain wall assemblies. Fit and assemble the work at the shop to the greatest extent possible. Disassemble only as required for shipment and erection. Maintain true continuity of line and accurate relation of planes and angles. Provide secure attachment and support at mechanical joints, with hairline fit and flush alignment of contacting members. Conceal fasteners.

E. Reinforce aluminum work as necessary at points of support or anchorage and at mechanical joints and points of attachment to meet performance requirements and for support of the system. Separate metal surfaces at moving joints with plastic inserts or other non-abrasive concealed inserts.

F. Factory-Assembled Frame Units
   1. Rigidly secure nonmovement joints.
   2. Prepare surfaces that are in contact with structural sealant with manufacturer's written instructions to ensure compatibility and adhesion.
   3. Preparation includes, but is not limited to, cleaning and priming surfaces.
   4. Seal joints watertight unless noted otherwise.
   5. Install glazing to comply with requirements of Section 08 80 00.

2.06 FINISHES

Anodized or color?

[A. All exposed aluminum surfaces shall receive an Architectural Class 1, clear anodized coating; AA-M12C22A41, minimum 0.7 mil thickness.]

[A. Finish: Fluoropolymer two coat baked on finish with Kynar 500 (70%) resins. See section 05 05 13.]

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East Tennessee State University     50% CD     GLAZED ALUMINUM CURTAINWALLS
[A. Exterior Surfaces: Fluoropolymer baked enamel finish with Kynar 500 (70%) resins by ELF ATOCHEM OF NORTH AMERICA INC.; "Trinar" by AKZO; "Duranar" by PPG; "Fluropon" by VALSPAR. Total dry film thickness not less than 1.0 mils, or coatings meet or exceed the requirements of AAMA 2605.]

1. Color: [As selected by Architect from paint manufacturer's complete specified line.] [To be coordinated with and match entrance door color and storefront framing color. See Section 08 41 13.]
3. Concealed members may be mill finished, providing they cannot be seen through the glass.

B. Interior Surfaces: Baked enamel finish; AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

C. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

**PART 3 EXECUTION**

3.01 INSPECTION

A. Examine substrates supporting structure and installation conditions. Do not proceed with curtain wall system erection until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

[C. Preinstallation Conference

1. Prior to installation of curtain wall and associated work, meet at project site, or other mutually agreed location, with installer, representative of curtain wall manufacturer, installers of related work, and other entities concerned with performance, including test agencies, governing authorities, Construction Manager, Architect, and Owner.
2. Record discussions and agreements and furnish a copy to each participant.
3. Provide at least 72 hours advance notice to participants prior to convening installation conference.
4. Meeting agenda shall include:
   a. Construction
   b. Safety
   c. Installed curtain wall protection
   d. Damage to installed curtain wall
3.02 INSTALLATION
A. General
1. Do not install component parts that are observed to be defective, including warped, bowed, dented, abraded and broken members. Remove and replace members that have been damaged during installation or thereafter before time of acceptance.
2. Do not cut or trim component parts during erection without advanced permission of the Architect, and acceptance from structural engineer.

B. Install the curtain wall system in accordance with the manufacturer's installation instructions and recommendations.

C. Install component parts level, plumb, true to line and with uniform joints and reveals. Secure to structure with non-staining and non-corrosive structural shims, anchors and bolts; never attach to wood blocking or through wood spacers.

D. Erection Tolerances: Install glazed aluminum curtain-wall systems to comply with the following maximum tolerances:
   1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
   2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
   3. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
      c. Where surfaces are separated by reveal or protruding element of 1 inch wide or greater, limit offset from true alignment to 1/4 inch.
   4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

E. Assembly and Anchorage: Anchor component parts securely in place, by bolting, which will comply with performance requirements and permits movements as required.

F. Install curtain wall system glass and glazing, in accordance with Section 08 81 00 and the manufacturer's requirements.

3.03 FIELD QUALITY CONTROL
A. Testing Agency: [Owner will] Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. All tests must be performed in the presence of the Architect, Construction Manager and Owner’s Representative. Provide a minimum of 72 hours notice prior to each test being performed.

[C. Test Area: Perform tests on areas approximately 25 feet wide by one story high. Actual test areas to be coordinated with Architect.]
[C. Test Area: Perform tests on areas indicated on the elevations. Actual test areas to be coordinated with Architect.]

D. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to ASTM E1105 and shall not show evidence of water penetration.
   a. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
   a. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

[E. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

1. Test a minimum of two areas on each building facade.
2. Repair installation areas damaged by testing.]

F. Repair or remove work where test results and inspections indicate that the work does not comply with specified requirements. Obtain authorization for remediation from Architect before accomplishing any repairs. Remediate and repeat test of that area, and test another similar area until all tests are successful.

G. Additional testing and inspecting, Contractor's expense, will be performed to determine compliance of replaced, remediated or additional work with specified requirements.

H. Prepare test and inspection reports.

3.04 CLEANING AND PROTECTION

A. Protect glass from breakage immediately upon installation. Attach streamers to framing. Do not apply markings or materials of any type to surfaces of glass.

B. Remove protective coating when completion of construction activities no longer require its retention.

C. Immediately before acceptance of the work, clean the aluminum curtain wall system thoroughly, inside and out. Demonstrate proper cleaning methods to Owner's maintenance personnel during final cleaning.

D. Prepare a "Cleaning and Maintenance Manual" listing types of cleaning compounds, cleaning methods, sealants and glazing materials used for cleaning,
repair, deglazing and reglazing and maintenance of work and turn over to Owner upon acceptance of the work.

END OF SECTION
PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included
   1. Automatic door operators, controls and accessories.
      a. Typical Units: Overhead, surface mounted.
   2. Doors specified under Section 08 41 13.
   3. Coordination
      a. Coordinate with finish hardware for compatibility of systems.
      b. Coordinate required voltages for electric items with Division 26.
      c. Coordinate with Section 08 41 13, Aluminum Entrances, to maintain
         single source responsibility for automatic operators and doors.
   4. Include necessary materials, devices and labor for a complete installation.
   5. Electrical work limited to internal system wiring and wiring to activating
      devices and on/off switches.

1.02 RELATED SECTIONS

A. Sealants: Section 07 92 00.
B. Aluminum Entrances: Section 08 41 13.
C. Glass: Section 08 81 00.
D. Electrical Work: Division 26.
   1. Electrical conduit.
   2. Power source.
   3. Final connection.
   4. Designated electric service.

1.03 REFERENCES

A. American National Standards Institute (ANSI)
   1. A156.10: Standard for Power Operated Pedestrian Doors
B. Underwriters' Laboratories (UL)
   1. UL325: Electric Door, Drapery, Gate, Louver and Window Operators and
      Systems.

1.04 SYSTEM DESCRIPTION

A. Automatic Door Operators
   1. Location/Type: Overhead, surface mount, heavy duty, electrically operated
   2. Function: Power assisted opening and closing of door; timing of sequence
      and hold-open period adjustable.
3. Action: See drawings for direction of swing, hand, etc.
4. Controls: Pressure sensitive floor mounted control mat and push button.

B. Performance Requirements
1. Emergency Exit Doors: Comply with requirements for doors serving as exit components in means of egress, as certified by the manufacturer for the condition shown.
2. Emergency Break Away: Meet requirements of ANSI A156.10.
3. Service Life: Operators to be capable of operating without failure of any component, for not less than 300,000 open and close cycles and wind velocities or equivalent inward differential pressures of 20 mph, with normal maintenance as defined in manufacturer’s standard operating manual.
4. Time Delay Setting: Operators adjustable to meet Owner’s requirements.
5. Load-Bearing Strength (Wind Resistance): Manufacturer’s stock system, adapted to application indicated, tested in accordance with ASTM E330 to withstand at least the following loadings:
   a. Uniform pressure of 20 psf inward and outward.

1.05 ELECTRIC COORDINATION

A. Power Supplies: Power supplies provided by Division 26 for all electrically operated hardware including the electric door operators.

B. The following electric devices are provided by Division 26:
   1. Conduit, relays, transformers.
   2. Junction boxes.

C. Voltages and Operation Requirements
   1. Operator: 120 VAC.
   2. Verify all voltages with Division 16 upon Contract award.

1.06 SUBMITTALS

A. Submit in accordance with the requirements of the General Conditions and Section 01 33 23.

B. Shop Drawings: Include complete elevations of the system; details and methods of anchorage; details of construction; finishes; methods of assembly; location and installation of hardware and reinforcement for same; size, shape and thickness of materials; joints and connections; details of joining other work. Show locations of all components.

C. Product Data: Complete product description. Include all electrical requirements and complete information required for electrical coordination.

D. Maintenance Data: Furnish written instructions to Owner describing recommended materials and methods for proper maintenance of opener system.
   1. Provide adjusting wrenches and other tools necessary for door adjustment and maintenance.
   2. Tag tools for positive identification and deliver to Owner prior to acceptance of work.
E. Maintenance Agreement
1. Installer shall provide continuing maintenance proposal to Owner for his consideration, in the form of a standard yearly maintenance agreement, starting on date construction contract maintenance requirements are concluded. State services, obligations and terms for agreement period, and for renewal options. Charges for this agreement shall not be part of the base contract price.

1.07 QUALITY ASSURANCE

A. Subcontract: Subcontract automatic door work to aluminum entrance contractor for proper coordination and single source responsibility where systems abut or connect to one another.

B. Standards: Provide automatic door operators complying with ANSI A156.10 and UL Standard 325.

C. Qualifications
1. Manufacturer: Provide units produced by a firm with not less than 5 years successful experience in the fabrication of automatic door equipment of the type required for this project.
2. Installer: Engage an installer who is an authorized representative of the automatic door equipment manufacturer for both the installation and the maintenance of the type of units required for this project.
   a. Minimum Experience: Not less than 3 years experience in the installation and service of automatic door equipment of same MFR.
   b. Maintenance Proximity: Not more than 1 hour normal travel time from Installer's place of business to project site.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store materials at job site so as to prevent damage to members or assemblies, and protect from corrosion or deterioration.

1.08 WARRANTY

A. Contractor(s): Provide a 2 year guarantee on all systems.
   1. Warrant systems free of defects due to faulty materials and workmanship.
   2. Include repair and replacement of defective materials and components at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide conforming products from one of the following:
   1. BESAM
   2. STANLEY
   3. DOR-O-MATIC
   4. GYRO TECH
2.02 MATERIALS

A. Exposed Metal
   1. Aluminum Extrusions and Aluminum Sheet
      a. Compatible with specified finish.
   2. Provide aluminum alloy and temper for each shape, as recommended by manufacturer and processor to comply with the requirements of performance, fabrication, application of finish, and control of color.

B. Aluminum Thickness
   1. Section thickness to meet design requirements.
   2. Moldings, Trim and Glass Stops: 0.05 inch minimum.

C. Concealed Metals: Manufacturer's standard, suitable for application.

D. Steel Reinforcements and Brackets: Manufacturer's standard units with 2.0 ounce hot-dip galvanized coating, ASTM A653. Applied after fabrication.

E. Fasteners: Aluminum, non-magnetic stainless steel, or other noncorrosive metal compatible with the items being fastened. For exposed fasteners, provide Phillips flat-head screws with finish matching the item fastened.

F. Sealants and Gaskets: Manufacturer's standard.

G. Bituminous Coatings: Cold applied asphalt mastic, SSPC-PAINT 12.

2.03 AUTOMATIC DOOR OPENER

A. Specification based on electric swing door system by BESAM, Model 450, overhead, surface mounted. See Part 1, Performance Requirements.

B. Operator Location: Controls and connecting hardware to mount above door frame; provide with removable aluminum access cover in front.
   1. Housing: Nominal 6" x 6" with finished end caps; See Materials hereinbefore. Minimum aluminum thickness 0.146 inch.

C. Operator Function: Manufacturer's standard electrical unit, powered in the opening cycle, spring return in the closing cycle and with speed control to provide checking in both cycles.
   1. Provide for manual operation when power is off, and provide emergency release for manual swing-out action of doors indicated to function as exits.
   2. Equip units with hold-open switch, arranged to hold door open without the continued use of power.

D. Operator Action: As indicated by door swing on drawings (swing-in, swing-out, double swing, pairs, etc.).

E. Electrical Control: Self-contained unit including necessary transformers, relays, rectifiers, and other electronic components for proper operation and switching of power operator.
   1. Relays: Plug-in type for individual replacement.
2. Connecting Harnesses: Provide with interlocking plugs.
3. Provide control with adjustable time delay module of 0-60 seconds.

F. Hardware
1. Manufacturer's standard arm and track device or direct connection to center pivots.
2. Keyed Switch: Manufacturer's standard key operated on/off switch; cylinder furnished under Section 08 71 00, Finish Hardware.

2.04 ACTUATING CONTROLS

A. Floor Mat Control Panels: Provide units of sizes indicated, but not less than that required by reference standards; complete with extruded aluminum mat frame, concealed anchorage; manufacturer's standard synthetic rubber or flexible plastic mat, safety ribbed surface pattern, standard color as selected; containing pressure switches for low voltage control wiring, and intended floor single-acting swing door control, with "Opening" section and "Safety" section switches.
1. Provide 1/2" thick mat.
2. Recessed Mounting: Provide recessed type frame.

B. Push Button: Provide 6" diameter stainless steel push button switch with handicapped insignia. Locate interior control button on wall as indicated.

2.05 HARDWARE

A. Provide hardware necessary for complete installation.

B. Automatic door opener supplier to coordinate all door preparation for hardware scheduled under Section 08 41 13, Aluminum Entrances.

2.06 ACCESSORIES

A. Marking: Provide caution decals on automatic doors in conformance with ANSI A156.10.

B. Miscellaneous: As required for complete installation.

2.07 FABRICATION

A. General
1. Sizes and Profiles: Required sizes for door and frame units, including profile requirements, as specified and as indicated on drawings.
2. Welding: Comply with AWS recommendations to avoid discoloration at welds; grind exposed welds smooth and restore mechanical finish.
3. Conceal fasteners where possible.
4. Maintain continuity of line and accurate relation of planes and angles. Provide secure attachment and support at mechanical joints, with hairline fit of contacting members.
5. Reinforce the work as necessary for performance requirements, and for support to the structure. Separate dissimilar metals with bituminous paint or preformed separators. Separate metal surfaces at moving joints with
non-metallic separators to prevent "freeze-up" of joints.

6. Weatherstripping: Where exterior door stiles or head rails do not close against fixed stops equipped with weatherstripping, provide weatherstripping, retained in an adjustable strip in a mortise centered in the edge of the door.

B. Aluminum Door and Sidelight Framing: Provided under Section 08 41 13, Aluminum Entrances. See Part 1, Description, for coordination with other products.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to which work of this Section applies. No work shall be installed until corrections to substrates have been performed by trades involved.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations and in compliance with referenced standards. Members shall be level, square, plumb, at proper elevations and in alignment with other work. Attach and secure to structure as required to assure stability of system.

B. Provide wiring from activating devices, controls, and remote on/off switches in conduit provided under Division 26.

C. All units to be free and smoothly operating without binding or rough spots; adjust as required and/or replace improperly functioning units.

D. After repeated operation of completed installation equivalent to three days use by normal traffic (100 to 300 cycles), readjust door operators and controls for optimum operating conditions and safety. Lubricate operating equipment and clean exposed surfaces.

E. Provide protective measures and other precautions required to ensure that automatic entrance doors will be without damage or deterioration, other than normal weathering, at time of substantial completion.

END OF SECTION
SECTION 08 81 00
GLASS AND GLAZING

PART 1 GENERAL

1.01 SCOPE

A. Work Included: Provide glass and glazing for all exterior and interior openings as indicated on the drawings and specified herein. Work also includes the following:
   1. Glass for metal framed skylight systems.
   2. Unframed mirrors.

B. Work Not Included: Glass and glazing not provided under this Section are as follows: Framed Mirrors: Section 10 28 13.

1.02 RELATED SECTIONS

A. Division 8: Glazed doors and windows.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss of glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated or specified are minimums and are for detailing purposes only. Confirm glass thickness by analyzing project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet, as a minimum, the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E1300, according to the following requirements:
   b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical under wind action.
      1) Load Duration: 60 seconds or less.
   c. Probability of Breakage for Sloped Glazing: 1 lite per 1000 lites set more than 15 degrees off vertical and under wind and snow action.
      1) Load Duration: 30 days.
   d. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1", whichever is less.
      1) For monolithic glass lites, heat treated to resist wind loads.
      2) For insulating glass.
3) For laminated glass lites.
   e. Minimum Glass Thickness for Exterior Lites “⅛”.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.

1.04 REFERENCED STANDARDS

A. Reference Standards: Wherever the following abbreviations are used herein, they shall refer to the corresponding standard.
   5. IGMA: Insulated Glass Manufacturers Alliance.

B. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations listed below, except where more stringent requirements are indicated herein.
   2. Insulated Glass Manufacturers Alliance (IGMA)
      a. TM-3000 "Vertical Glazing Guidelines"
      b. TB-3001 "Sloped Glazing Guidelines".
   3. American Architectural Manufacturers Association (AAMA)
      a. TIR-A7 "Sloped Glazing Guidelines"
      b. GDSG-1 "Glass Design for Sloped Glazing".

1.04 QUALITY ASSURANCE

[ A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this project and who employs glass installers for this project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).]

[ A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this project.]

B. Fire-Rated Door Assemblies: Provide assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

C. Fire-Rated Window Assemblies: Provide assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities...
having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.


E. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or on at least one component lite of unit with appropriate certification label of Insulating Glass Certification Council (IGCC).

F. Allowable Tolerances: Thicknesses of glass specified are nominal; provide glass manufactured to tolerances listed in GANA Manual.

G. Fire-Rated Glass: Each lite shall bear permanent, non-removable label of UL certifying it for use in tested and rated fire protective assemblies.

1.05 SUBMITTALS

A. Submit manufacturer's product data and installation instructions for each type of glass, glazing sealants and accessories required.
   1. Indicate structural, physical and environmental characteristics, size limitations, special handling requirements, etc.

B. Submit insulating glass manufacturer's certification indicating units meet or exceed specified requirements.

C. Submit laminated glass manufacturer's certification indicating units meet or exceed specified requirements.

D. Shop Drawings: Required data for shop drawings on glazing may be incorporated with shop drawings for framing members. Show thicknesses of glass; proposed "bites" in frames, sizes and locations of blocks, clips, beads, stops edge treatments; note quality, type and strength of each lite.

E. Samples: Submit and obtain approval of samples before proceeding with glass fabrication. Minimum two 12" x 12" samples of each glass type required, except clear monolithic glass. Submit color samples of exposed sealants and/or gaskets.

F. Special Environmental Requirements: Submit the following in accordance with Section 01 81 13): Product Data: For Sealant and Adhesives, documentation indicating VOC Content

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle glazing materials in accordance with manufacturer's recommendations to prevent damage and deterioration.

B. Various items to receive glazing as specified elsewhere may be factory-glazed or site-glazed at Contractor's option.

C. Deliver glazing compounds and sealants in manufacturer's unopened labeled containers.
D. Deliver glass with manufacturer's labels intact. Do not remove labels until glass has been installed.

1.07 PROJECT CONDITIONS

A. Field verify measurements and conditions of installations.

B. Examine all details. Provide proper fitting for details indicated.

C. Do not perform work under adverse weather or job site conditions. Install liquid sealants when temperatures are within lower or middle third of temperature range recommendations by manufacturer.

D. Protect work from damage during and after installation until project acceptance.

1.08 WARRANTY

A. Contractor to guarantee work under this Section against defects of materials, fabrication and installation. Guarantee period is one year, except where specified otherwise. Defects include, but are not necessarily limited to:
   1. Weather tightness: Two (2) year warranty.

B. Insulating Glass: Submit manufacturer's written warranty that for ten (10) years from date of substantial completion, a replacement will be provided (furnished and installed) for any unit which develops edge separation, thermal stress cracks, or other defects which materially obstruct vision through the glass or affect thermal and physical integrity of insulating glass units, except warranty shall not cover glass breakage from other than natural causes. Defective units shall be replaced at no additional cost to the Owner.

C. Laminated Glass: Submit manufacturer's written warranty that for five (5) years from date of substantial completion a replacement will be provided for laminated glass having manufacturing defects which result in edge separation or other defects which materially obstruct vision through the glass. Defective units shall be replaced at no additional cost to the Owner.

D. Coated Glass: Submit manufacturer's written warranty that for five (5) years from date of substantial completion, a replacement will be provided for defective units. Defects are defined as peeling, cracking or deterioration in coating due to normal conditions and not due to handling or installation contrary to glass manufacturer's published instructions. Defective units shall be replaced at no additional cost to the Owner.

E. Mirror: Submit manufacturer's ten (10) year warranty against silver spoilage. A replacement will be provided for mirrors that develop visible defects. Defective units shall be replaced at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURER
A. Acceptable Manufacturers and Fabricators: Specifications herein are based on glass and materials manufactured or fabricated by the following companies. Not all firms listed manufacture or fabricate all the items specified herein. However, to ensure consistent quality of appearance and performance, provide each type or kind of glass or material from a single source. Manufacturers for specialty products are listed within the specification to establish a particular type, color, pattern, etc. Equal products by the manufacturers listed are acceptable providing they meet the type, color, pattern, etc. as approved by the Architect.

1. Manufacturers
   a. AGC FLOAT GLASS NORTH AMERICA
   b. VITRO
   c. GUARDIAN INDUSTRIES

2. Fabricators
   a. VIRACON
   b. OLDCASTLE BUILDINGENVELOPE
   c. ARCH ALUMINUM & GLASS LLC
   d. TRULITE GLASS AND ALUMINUM

2.02 PRIMARY FLOAT GLASS

A. Conformance: Type I, Class 1 for clear glass, Class 2-tinted heat-absorbing and light-reducing; Class 3 for tinted, light-reducing glass, Quality q³, conforming to ASTM C1036.

B. Thickness: 1/4", unless otherwise indicated.

C. Color: Clear.
   1. When used in insulating units, provide color specified under each insulating unit.

2.03 HEAT TREATED FLOAT GLASS

A. Conformance: Condition A, Kind FT [Kind HS]. Type I, Class 1 for clear glass, Class 2-tinted heat-absorbing and light-reducing; Class 3 for tinted, light-reducing glass, conforming to ASTM C1048.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
   2. Roll Wave Maximum Distortion Tolerance: 0.003 inch target with 0.005 inch maximum peak to valley measurement.

B. Thickness: 1/4", unless otherwise indicated.

C. Color: Clear.
   1. When used in insulating units, provide color specified under each insulating unit.

D. Locations: Safety glazing locations as designated and required by applicable code(s).
2.04  COATED FLOAT GLASS

A. General: Provide coated glass complying with this article and in schedules at the end of Part 3.

B. Low E, Sputter Coated Float Glass: Float glass with metallic-oxide or metallic nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), complying with requirements specified in schedules at end of Part 3.

C. Coated Spandrel Float Glass:
   2. Conformance: Condition B, Kind FT [Kind HS], Type I, Class 1, conforming to ASTM C1048.
   3. Thickness: 1/4", unless otherwise indicated.
   4. Color: [As selected by Architect] [VIRACON V903 Subdued Gray].

2.05  WIRE GLASS: USE PROHIBITED.

2.06  LAMINATED GLASS

A. Conformance: Kind LHS conforming to ASTM C1172 "Laminated Architectural Flat Glass" and ANSI Z97.1.

[B. Thickness: Each pane 1/8" inch. (Total thickness equals both panes plus interlayer).]

[B. Thickness
   1. Interior: Each pane 1/8" inch. (Total thickness equals both panes plus interlayer).
   2. Skylight: Each pane 1/4" inch.]

C. Interlayer: As indicated below; clear or in colors/patterns indicated; with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

D. Laminating Process: Fabricate to produce glass free of foreign substances and air or glass pockets as follows:
   1. Laminate lites with polyvinyl butyral interlayer in autoclave with heat plus pressure.

2.07  INSULATING GLASS

A. Sealed Insulating Glass: General: Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E2190 for performance classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, spacer material, corner design and desiccant.

1. For properties of individual glass making up units, refer to requirements specified in schedule at the end of Part 3 as applicable to types, kinds, classes and conditions.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites to comply with glass design requirements. Provide Kind FT (fully tempered) where safety glass is indicated or required.

B. Edge Construction: Double sealed with a primary seal of polyisobutylene and a secondary seal of silicone. Delete low-E coating prior to fabrication of insulating units according to coated glass manufacturer's instructions.

choose

[1. Spacer to have mill or clear anodized finish.]
[1. Spacer to be black; clear aluminum color not permitted.]

2.08 MISCELLANEOUS GLASS TYPES

A. Unframed Mirror
1. Description: Clear float glass conforming with ASTM C1036, Type 1, Class 1, Quality q2, with full silver coating, copper coating and protective back coating.
2. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.
3. Thickness: 1/4”.
4. Size: As indicated on schedule.
5. Adhesive: Type as recommended by mirror manufacturer produced specifically for setting mirrors by spot application on all types of substrates encountered. PALMER PRODUCTS CORPORATION “Mirro-Mastic”, SOVEREIGN SPECIALTY CHEMICAL “Nail Power Mirror Mastic, ROYAL ADHESIVES & SEALANTS “Gunther Pro”.

B. One-Way Vision Glass: Clear ¼” thick float glass with stainless steel metallic coating on viewer side. Transparent Mirror by GUARDIAN or equal.

C. Fire-Rated Glass
1. 20 Minute - For use in 20 minute rated doors only. Superlite I manufactured by SAFTI FIRST, PyroEdge-20 by AGC GLASS COMPANY, SGG Pyroswiss US by VETROTECH SAINT GOBAIN or Fireglass 20 by TECHNICAL GLASS PRODUCTS. ⅛” thick tempered glass with a 20 minute fire-rating.
2. 45 Minute - For use in 45 minute door and window applications. Superlite II-XL manufactured by SAFTI FIRST, Pyrobel by AGC GLASS COMPANY, SGG Swissflam-45 by VETROTECH SAINT GOBAIN or Pyrostop by PILKINGTON. ⅜” thick unit comprised of inboard and outboard tempered lites protecting a fire resistive interlayer.
3. 60 or 90 minute Doors - For use in 60 or 90 minute door applications, must comply with CPSC Category I and limited to 100 square inches in size. Superlite X-90 manufactured by SAFTI FIRST, Pyran Platinum L by SCHOTT, SGG Keralite FR-L by VETROTECH SAINT GOBAIN or Firelite Plus by TECHNICAL GLASS PRODUCTS. ⅜” thick safety rated glass.
4. 60, 90 or 120 Minute - For use in 60, 90, or 120 door/window/wall applications, must comply with ASTM E119 requirements as a barrier to radiant heat. Superlite II-XL manufactured by SAFTI FIRST, Pyrobel by AGC GLASS COMPANY, SGG Contraflam by VETROTECH SAINT GOBAIN or Pyrostop by PILKINGTON. 1” to 1-1/2” in thickness depending...
on rating, unit comprised of inboard and outboard tempered lites protecting a fire resistive interlayer. For use in Fire-Resistive framing from glass manufacturer only, standard hollow metal is not acceptable.

5. 180 Minute Doors - For use in 180 minute door applications, must comply with CPSC Category I and limited to 100 square inches in size. Pyran Platinum F fabricated by SAFTI FIRST, Pyran Platinum F by SCHOTT or FireLite NT by TECHNICAL GLASS PRODUCTS. Nominal ¼” thick polished ceramic glazing with impact film applied to one side.

6. All fire-rated glazing to have Logo: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, name of manufacturer, testing laboratory, fire rating period, and safety glazing standards.

E. Obscure Tempered Glass (Patterned)

1. Reference: ASTM C1036, Type II, Class 1, Form 3, Quality q8, Finish f1, Pattern p3.
2. Thickness: ¼ inch.
3. Amount of pattern or frost as approved by Architect.

2.09 ACID ETCHED GLASS

A. Reference: ASTM C1048, heat treated HS, kind FT coated and uncoated Thickness: ¼ inch. DILLMEIER, GUARDIAN and WALKER GLASS.

B. Amount of etch look as selected by Architect from manufacturers full range. Selection to be in the 50% range.

2.10 ACRYLIC PANELS

A. Laminated unfilled acrylic with embedding material manufactured by 3FORM DESIGNTEX, LIGHTBLOX

1. Performance Properties
   a. Tensile Strength – ASTM D638: 10,000 psi.
   b. Flexural Strength – ASTM D790: 14,600 psi.
   c. Abrasion Resistance – ASTM D1044
   d. 10 Cycles: Haze 15%
   e. 200 Cycles: Haze 50%
   g. Tensile Impact Strength – ASTM D1822: 20 ft. lbs./in².

2. Thickness: As detailed on the drawings.
3. Frost type pattern; as selected by Architect.

2.11 GLAZING MATERIALS AND ACCESSORIES

A. Glazing Sealants and Compounds

1. General: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule #1168, AND all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
2. Comply with manufacturer's recommendations for selection of hardness. Select materials and variations or modifications for compatibility with surfaces contacted in the installation.

3. Exterior Glazing: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

   a. Glazing Sealant: One-part neutral-curing silicone glazing sealant, ASTM C 920 Class A, Type S, Grade NS, Class 100/50, Use NT; for high movement joints at metal-to metal and glass to metal.
      1) Dow Corning Corporation; 790
      2) GE Advanced Materials - Silicones; SilPruf LM SCS2700
      3) Pecora Corporation; 890
      4) Tremco Incorporated; Spectrem 1

   b. Glazing Sealant: One-part neutral-curing silicone glazing sealant, ASTM C 920, Type S, Grade NS, Class 50, Use NT; for general applications in glazing installation subject to high movement including perimeter; use non-staining formula at absorbent perimeter applications
      1) DOW CORNING CORPORATION; 795 or 756 SMS
      2) GE ADVANCED MATERIALS - SILICONES; SilPruf NB SCS9000 or SilPruf SCS2000
      3) PECORA CORPORATION; 864
      4) TREMCO INCORPORATED; Spectrem 2

   c. Glazing Sealant: One-part neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT; for general applications in glazing installation including perimeter; use non-staining formula at absorbent perimeter applications.
      1) DOW CORNING CORPORATION; 791
      2) GE ADVANCED MATERIALS - SILICONES; UltraGlaze SSG4000 or UltraGlaze SSG4000AC
      3) TREMCO INCORPORATED; Proglaze SSG or Tremsil 600

   d. Structural Glazing Sealant: ASTM C1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in glazing assembly indicated.
      1) DOW CORNING CORPORATION; 995.
      2) GE ADVANCED MATERIALS - SILICONES; UltraGlaze SSG4000.
      3) PECORA CORPORATION; 896.
      4) TREMCO INCORPORATED; Proglaze SG.

3. Interior Glazing: Compound of polymerized butyl rubber and inert fillers, with or without polyisobutylene modification, solvent based, 95% solids, formed and coiled on release paper, tack-free in 24 hours, paintable, non-staining.

B. Miscellaneous Glazing Materials
1. Cleaners, Primers and Sealers: Type recommended by sealant or gasket
2. Setting Blocks: Neoprene or EPDM, 80-90 durometer hardness, with proven compatibility with sealants used.

3. Spacers: EPDM, 40-50 durometer hardness with proven compatibility with sealants used.

4. Compressible Filler (Rod): Closed cell or waterproof jacketed rod stock of synthetic rubber or plastic form, compatible space with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.

C. Glazing Film: Fasara Interior Design Film manufactured by 3M ENERGY CONTROL PRODUCTS or equal by VISTA FILMS, CP FILMS, EASTMAN PERFORMANCE FILMS - SOLUTIA or DECORATIVE FILM, LLC.
   1. Design: Etched glass appearance. Amount of etch look as selected by Architect from manufacturer full range. Selection to be in the 50% range.

D. Applied Safety Glazing Film: Provide safety glazing film meeting ANSI Z97.1, Section 5.1 for impact resistance and ASTM E84 for surface burning characteristics.
   1. [EXAMPLE - Apply to corridor side of all existing glass at [list rooms, corridors]
   2. [EXAMPLE - Apply to existing glass entrance doors.]
   3. 3M Scotchshield Ultra Film; SHATTERGARD INC. Safety Glazing Film; LLUMAR Window Film; BEKAERT SPECIALTY FILMS.

2.12 FABRICATION

A. General: Fabricate glass and other glazing products in sizes required to glaze openings indicated, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

B. Glass Cutting: Cut glass to accurate sizes and shapes as indicated on drawings. Allow edge clearances and tolerances in accordance with GANA recommendations.
   1. Edges: Provide factory-cutting and factory-formed edges for all butt-glazed, heat tempered and insulating glass. Provide ground edges for all drilled holes, notches and other fabrication or finishing techniques.
   2. Butt-Glazed Systems: All work in accordance with manufacturer’s recommendations.
      a. Edges Exposed to Air: Polished finish.

C. Heat Strengthened and Tempered Glass
   1. Heat Strengthened: Heat treated to strengthen glass in bending to not less than 2.0 times annealed strength for the strengthened glass.
   2. Tempered: Heat treated to strengthen glass in bending to not less than 4 to 5 times annealed glass strength for the strengthened glass.
   3. Cut glass to required size before tempering. Comply with Glass Tempering Association recommendations.
   4. Provide tongless tempered glass. When size limitations require tong edges, support each piece during tempering process so that tong marks will
be concealed in the glazed system.

PART 3  EXECUTION

3.01  INSPECTION

A. Examine substrates, substructure and installation conditions. Do not proceed with glazing work until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02  PROTECTION AND PREPARATION

A. Protect glass from edge damage during handling and installation. Remove and legally dispose damaged glass off of the project site. Damaged glass is defined as glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and/or appearance.

B. Do not cut, seam, nip or abrade tempered glass.

C. Inspect each piece of glass immediately before installation and eliminate any which have observable edge damage or face imperfections.

D. Unify appearance of each series of lights by setting each piece to match other pieces, as nearly as possible. Inspect each piece and set with pattern, draw, and bow oriented in same direction as other pieces.

E. Clean glazing channels and other framing members to receive glass immediately before glazing. Remove loose coatings. Apply primer to joint surfaces receiving sealants when recommended by sealant manufacturer.

3.03  INSTALLATION - GENERAL

A. Comply with combined recommendations and technical reports of manufacturer's of glass and glazing materials used with GANA "Glazing Manual", except when more stringent requirements are indicated.

B. Install insulating units to comply with recommendations by IGMA, except as otherwise specifically indicated or recommended by glass and sealant manufacturers.

C. Glazing channel dimensions shown are intended to provide for necessary bite on glass, minimum edge clearance and adequate sealant thickness, with reasonable tolerance. Adjust as required by job conditions at time of installation.

D. Install setting blocks in sill rabbets, properly sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Install primers, sealants, tapes, and gaskets in accordance with manufacturer's
recommendations. Set glass without springing and install securely to prevent rattling or breakage.

F. Where wedge-shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure gasket will not "walk" out when subjected to dynamic movement. Anchor gasket to stop with matching ribs, or by proved adhesives, including embedment of gasket tail in cured heal bead.

1. Miter cut and bond gasket ends together at corners where gaskets will not pull away from corners and result in voids or leaks in the glazing system.

G. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

3.04 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes edge-to-edge, but not necessarily in one continuous length. Do not stretch tapes to make them fit openings.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.05 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gaskets by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints
with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealant to provide a substantial wash away from glass.

3.07 PROTECTION AND CLEANING

A. Protect glass from breakage immediately upon installation by attachment of streamers to framing held away from glass. Do not apply markers of any type to surfaces of glass. Remove non-permanent labels and clean surfaces.

B. Maintain glass in a reasonable clean condition during construction so that it will not be damaged by corrosive action, and will not contribute (by wash off) to the deterioration of glazing materials and other work. Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents and vandalism.

C. Wash and polish on both faces not more than four days before acceptance of the work. Comply with glass manufacturer's recommendations for final cleaning.

3.08 GLAZING SCHEDULE

If you want something different than A & B – EDIT PRECISELY

A. Insulating Glass – IG-1 and IG-1A

1. Type: Two thicknesses of float or tempered glass, as required by code.
2. Glass/Color
   a. Interior Pane
      1) IG-1
         a) Type I (transparent, flat)
         b) Class 1 (clear)
         c) Quality q3 (select)
      2) IG-1A
         a) Type 1 (transparent, flat)
         b) Kind: FT (fully tempered)
         c) Class 1 (clear)
         d) Quality q3 (select)
   b. Exterior Pane: VIRACON Solarscreen 2000 Low E VE 1-2M
      1) IG-1
         a) Type I (transparent, flat)
b) Class 1 (clear)
c) Quality q3 (select)
d) Low-Emissivity Coating: Sputtered on #2 surface.

2) IG-1A
   a) Type 1 (transparent, flat)
   b) Kind: FT (fully tempered)
   c) Class 1 (clear)
   d) Quality q3 (select)
   e) Low-Emissivity Coating: Sputtered on #2 surface.

3. Unit Thickness: 1" (two 1/4" panes and 1/2" air space).
4. Thermal Conductance (U-Value): 0.28 Summer Daytime.
5. Transmittance
   a. Ultraviolet %: 10.
   b. Visible %: 70.
   c. Solar %: 32.

6. Shading Coefficient: 0.43.
7. Solar Factor (SHGC): 0.37.

B. Insulating Glass – IG-2 and IG-2A

1. Type: Two thicknesses of float or tempered glass, as required by code.
2. Glass/Color
   a. Interior Pane: Clear.
      1) IG-1
         a) Type I (transparent, flat)
         b) Class 1 (clear)
         c) Quality q3 (select)
      2) IG-1A
         a) Type 1 (transparent, flat)
         b) Kind: FT (fully tempered)
         c) Class 1 (clear)
         d) Quality q3 (select)

   b. Exterior Pane: VIRACON Solarscreen Low E VE 6-52
      1) IG-2
         a) Type I (transparent, flat)
         b) Class 2 (tinted, heat-absorbing, light-reducing)
         c) Quality q3 (select)
         d) Low-Emissivity Coating: Sputtered on #2 surface.
      2) IG-2A
         a) Type 1 (transparent, flat)
         b) Kind: FT (fully tempered)
         c) Class 2 (tinted, heat-absorbing, light-reducing)
         d) Quality q3 (select)
         e) Low-Emissivity Coating: Sputtered on #2 surface.

3. Unit Thickness: 1" (two 1/4" panes and 1/2" air space).
4. Thermal Conductance (U-Value): 0.33 Summer Daytime.
5. Transmittance
   a. Ultraviolet %: 11.
   b. Visible %: 42.
   c. Solar %: 22.

6. Shading Coefficient: 0.34.
7. Solar Factor (SHGC): 0.29.
C. Insulating Skylight Glass: Nominal ½" thick. VIRACON Laminated Solarscreen Low-E, VE 11-50, which has a transmission of 53%, reflectance of 14%, and shading coefficient of .53 Winter U value is .97, Summer U value is .88

1. Type
2. Glass/Color
   a. Interior Pane: Blue; Nominal ½" thick. VIRACON Laminated Solarscreen Low-E, VE 11-50; both panes heat strengthened.
   b. Exterior Pane
      1) Type I (transparent, flat)
      2) Class 1 (clear)
      3) Quality q3 (select)
3. Unit Thickness: 1-1/4" (one 1/4" pane, one ½" pane and 1/2" air space).
4. Thermal Conductance (U-Value): 0.29 Summer Daytime.
5. Transmittance
   a. Ultraviolet %: 1.
   b. Visible %: 31.
   c. Solar %: 17.
6. Reflectance
7. Shading Coefficient: 0.31.
8. Solar Factor (SHGC): 0.27.

D. Insulating Spandrel Glass

1. Description: Spandrel/clear.
2. Outer Pane: Spandrel glass as specified herein.
3. Inner Pane: Clear float
4. Thickness: 1/4" each pane.
5. Air Space: 1/2".
6. Unit Thickness: 1".

END OF SECTION
SECTION 08 83 00
MIRRORS

PART 1   GENERAL

1.01  SUMMARY

A. This Section includes the following types of silvered flat glass mirrors.
   1. Annealed monolithic glass mirrors.
   2. Tempered monolithic glass mirrors.

1.02  RELATED SECTIONS

A. Glass and Glazing: Section 08 81 00.

B. Section 10 28 13: Toilet Accessories (Framed Mirrors).

1.03  DEFINITIONS

A. Deterioration of Mirrors: Defects developed from normal use are attributable to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, clouding of the silver film.

1.04  PERFORMANCE REQUIREMENTS

A. Provide mirrors that will not fail under normal usage. Failure includes breakage, deterioration attributable to defective manufacture, fabrication, and installation.

1.05  SUBMITTALS

A. Shop Drawings: Include mirror elevations indicating vertical joint layout, edge details, mirror hardware, and attachments to other work.

B. Samples: For each type of mirror product required, provide mirrors, 12 inches square, including edge and frame treatment on 2 adjoining edges.

C. Product Certificates: For each type of mirror and mastic signed by manufacturer.

D. Qualification Data: For Installer.

E. Mirror Mastic Compatibility Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing film and substrates on which mirrors are installed.

F. Warranty: Special warranty specified in this Section.

1.06  QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed mirror
glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in mirror installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under NGA’s Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

B. Source Limitations for Mirrors: Obtain mirrors from one source for each type of mirror indicated.

C. Source Limitations for Mirror Glazing Accessories: Obtain mirror glazing accessories from one source for each type of accessory indicated.

D. Glazing Publications: Comply with the following published recommendations:
   1. GANA’s "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
   2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

E. Reference Standards
      a. ASTM C1503: Standard Spec. for Silvered Flat Glass Mirror
      b. ASTM C1036: Standard Specification for Flat Glass
      c. ASTM C1048: Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass

F. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

G. Safety Backed Mirrors: For annealed mirrors applying a sheet of adhesive backed polyethylene material to the back per CPSC 16 CFR 1201 and ANSI Z97.1 standards.

H. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing film and various substrates on which mirrors are installed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer’s written instructions and as needed to prevent damage to mirrors from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer’s written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.
1.09 **WARRANTY**

A. Special Warranty: Manufacturer's standard form, made out to Owner and signed by mirror manufacturer agreeing to replace mirrors that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below:

1. Warranty Period: Five (5) years from date of Contract Completion.

**PART 2  PRODUCTS**

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide the following:

1. ARCH ALUMINUM & GLASS CO., INC.
2. GARDNER GLASS PRODUCTS.
3. GUARDIAN INDUSTRIES CORP.
4. LENOIR MIRROR COMPANY.
5. VIRGINIA MIRROR COMPANY, INC.

2.02 **SILVERED FLAT GLASS MIRROR MATERIALS**

A. Tempered Clear Glass Mirrors: Comply with ASTM C1503, Mirror Glazing Quality, for blemish requirements in annealed float glass before silver coating is applied, for coating requirements, and with other requirements not affected by tempering process; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.

1. Nominal Thickness: ¼”.

B. Annealed Clear Glass Mirrors: Comply with ASTM C1503, Mirror Glazing Quality; clear float glass conforming with ASTM C1036, Type 1, Class 1, Quality q^+_.

1. Nominal Thickness: ¼”.

2.03 **MISCELLANEOUS MATERIALS**

A. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. GUNTHER MIRROR MASTICS.
   b. PALMER PRODUCTS CORPORATION.
   c. FRANKLIN INTERNATIONAL; TITEBOND

2. Adhesive shall have a VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep
enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

1. Bottom: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) EPCO Model 2010.
      2) C. R. LAURENCE Standard J-Channel
      3) SOMMER and MACA INDUSTRIES Aluminum Shallow Nose "J" Moulding Lower Bar.

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively and thickness of not less than 0.04 inch.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) EPCO Model 2013
      2) C. R. LAURENCE Deep J-Channel
      3) SOMMER and MACA INDUSTRIES Aluminum Deep Nose "J" Moulding Upper Bar.


4. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.04 FABRICATION

A. Mirror Sizes: To suit Project conditions, and before tempering, cut mirrors to final sizes and shapes. See drawings for sizes. At wall-to-wall conditions, field verify dimensions prior to fabricating mirrors.

B. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Beveled polished edge of width shown.
   1. Seal edges of mirrors after edge treatment to prevent chemical or atmospheric penetration of glass coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance.
   1. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
   2. Proceed with mirror installation only after unsatisfactory conditions have been corrected and surfaces are dry.
3.02 PREPARATION

A. Comply with mastic manufacturer’s written installation instructions for preparation of substrates, including coating surfaces with mastic manufacturer’s special bond coating where applicable.

3.03 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer’s written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Provide a minimum air space of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. For wall-mounted mirrors, install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

   1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.

   2. Install mastic as follows:
       a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
       b. Apply mastic to comply with mastic manufacturer’s written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
       c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch between back of mirrors and mounting surface.

3.04 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

END OF SECTION
SECTION 08 91 19

FIXED LOUVERS

PART 1  GENERAL

1.01  SCOPE

A. Provide wall louvers as indicated. All louvers on exterior of building to be provided under this Section.

1.02  RELATED SECTIONS

A. Sealant: Section 07 92 00.

1.03  QUALITY ASSURANCE

A. Reference Standards: Wherever the following abbreviations are used herein, they shall refer to the corresponding standard.
   2. SMACNA: Sheet Metal & Air Conditioning Contractors National Association

B. Performance Requirements: Provide units whose performance ratings have been determined in compliance with AMCA Standard 500 and 511.

C. Water Penetration and Free Area: Meet AMCA Standard for louvers specified.

D. Wind Load: Design louvers and supports for 20 pounds per square foot wind load.

E. Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, installation procedures, unless otherwise indicated.

F. Field Measurements: Verify size, location and placement of louver units prior to fabrication wherever possible.

G. Shop Assembly: Coordinate field measurements with fabrication, shop assembly.

H. Factory painted finish to be performed by an applicator specifically approved by paint manufacturer. The applicator shall provide written notification of approval by paint manufacturer prior to application of the finish.

1.04  SUBMITTALS

A. Product Data: Submit manufacturer's specifications; certified test data, where applicable; and installation instructions for required products, including finishes. Finish type and color to be determined by location of use.
B. Shop Drawings: Submit plans, elevations and details of sections and connections to adjoining work. Indicate materials, finishes, fasteners, joinery and other information to determine compliance with specified requirements.

C. Samples Aluminum Fluoropolymer Finish (per 2.06.A): Submit three samples, on metal of same gage and alloy to be used in the work, 6” square, of each required.

D. Samples Aluminum Anodized Finish (per 2.06.B): Submit finish samples showing the light and dark range limits of the anodizing color. These finish samples will be used in the field as a check for items specified in this Section. Anodized items whose color does not fall within the range indicated by these samples are unacceptable and shall not be used in the finished work.

**PART 2  PRODUCTS**

2.01  MATERIALS

A. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005 with temper as required for forming or as recommended by metal producer to provide required finish.

B. Aluminum Extrusions: ASTM B 221. Alloy 6063-T52.

C. Fasteners: Stainless Steel, 300 series.

D. Anchors and Inserts: Use non-ferrous metal anchors, inserts for exterior installation

E. Bituminous Paint: Acid and alkali resistant solvent type black bituminous mastic.

2.02  FABRICATION, GENERAL

A. Provide louvers and accessories of design, materials, sizes, depth, arrangement and metal thicknesses indicated, or if not indicated, as required for optimum performance with respect to airflow; water penetration; strength; durability and uniform appearance as suited to applications shown and intended use.

B. Fabricate frames including integral sills to suit adjacent construction with adequate tolerances for installation including application of sealant in joints between louvers and adjoining work, where applicable.

C. Include supports, anchorages and accessories required to achieve a complete assembly, properly installed.

D. Provide sill extensions and loose sills made of same material as louvers, where indicated or required, for drainage to exterior and to prevent water penetrating to interior.

E. Join frame members to one another and to stationary louver blades by field bolted connections made necessary by size of louvers. Maintain equal blade spacing including separation between blades and frames at head and sill to produce a uniform appearance.
F. Provide hinged louver section where indicated. Hinged panel to appear as frameless from building exterior. Louver blades on hinged section to align with fixed panels at jambs.
   1. Hinge: Minimum .093" thick aluminum; 3" continuous type’ ¼" diameter pin. Finish to match louver blades. Provide with 6" stainless steel screws at maximum 6" on center.
   2. Lock: Provide aluminum plates, shaped and located as detailed on the drawings. Padlock provided by University.
   3. Finish: Finish all exposed surfaces of hinged louver section to match louver blades.

2.03 STATIONARY EXTRUDED ALUMINUM WALL LOUVERS

A. Horizontal Blade Louvers: Size and depth indicated, with blades of profile, slope and spacing indicated, or if not indicated, to meet performance requirements.
   1. Extrusion Thickness: Not less than .081" for blades and frames.
   2. Furnish units complying with following performance requirements.
      a. Free Area: Not less than 45%; unless otherwise indicated.
      b. Water Penetration: Not more than 0.01 oz. per square foot of free area at an minimum intake airflow of 1000 fpm free area velocity.

B. Manufacturer and Type: Provide louver vane profile to match AIROLITE K6774 manufactured by AIROLITE; AIRLINE; ARROW; CONSTRUCTION SPECIALTIES; INDUSTRIAL LOUVERS; AMERICAN WARMING AND VENTALATING; RUSKIN; RELIABLE or PENN AIRSTREAM.

2.04 LOUVER SCREENS

A. Provide screens for exterior louvers.

B. Fabricate screen frames of the same metal and finish as the louver units to which secured, unless otherwise indicated.

C. Provide frames of U-shaped metal for permanently securing screen mesh.

D. Size: 1/2" sq. mesh, 0.063" anodized aluminum wire.

E. Locate screens on inside face of louvers. Secure screens to louver frames with machine screws, spaced at each corner and at 12" o.c. between.

2.05 BLANK-OFF PANELS

A. Blank-Off Panels: Laminated panels consisting of rigid extruded polystyrene or polyurethane insulation core and .032 aluminum facing sheets.
   1. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer’s standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
   2. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
   3. Finish: Provide with finish to match louvers.
2.06 METAL FINISHES

A. Aluminum Finishes: Fluoropolymer baked enamel finish with Kynar 500 (70%) resins by ELF ATOCHEM OF NORTH AMERICA INC.; "Trinar" by AKZO; "Duranar" by PPG; "Fluropon" by VALSPAR. Total dry film thickness not less than 1.0 mils, or coatings meet or exceed the requirements of AAMA 2605.
   1. Color: As selected from paint manufacturer's complete specified line.

B. Aluminum Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, unless otherwise indicated. Apply finishes in factory after products are assembled. Protect finishes on exposed surfaces with protective covering, prior to shipment. Remove all scratches and blemishes from exposed surfaces visible after completing finishing process.
   1. Finish: All exposed aluminum surfaces shall receive an Architectural Class 1, clear anodized coating; AA-M12C22A41, minimum 0.7 mil thickness.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions and directions for the installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate the delivery of such items to the project site.

3.03 INSTALLATION

A. Locate and place louver units plumb, level and in proper alignment with adjacent work.

B. Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealant and joint fillers as indicated.

D. Repair damaged finishes. Restore finishes so that there is no evidence of corrective work. Return items which cannot be refinished in the field to the shop, make the required alterations, and refill the entire unit, or provide new units, as directed by Architect.
E. Protect galvanized and non-ferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry or dissimilar metals.

F. Provide concealed gaskets and flashing and install as the work progresses to make the installations weathertight.

G. Refer to Section 07 92 00 for sealant in connection with installation of louvers.

3.04 CLEANING

A. Clean louver surfaces in accordance with manufacturer's instructions. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces in accordance with manufacturer's instructions.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION
PART 1  GENERAL

1.01  SCOPE

A. Provide gypsum board systems consisting of wall board and framing as indicated and specified. Work includes:
   1. Gypsum drywall wall systems.
   2. Suspended drywall ceilings / soffits including suspension framing system.
   3. Fire-rated gypsum drywall construction where indicated.
   4. Exterior gypsum board sheathing.
   5. Exterior soffits and ceilings.
   6. Edge trim, corner beads, control joints, accent reveals, fasteners, joint treatment materials and other accessories required for complete installation.
   7. Includes installation of acoustical insulation specified in Section 07 21 00.
   8. Installation of metal access doors, including those provided by Plumbing and HVAC Contractors. See Section 08 31 13 and Divisions 22 and 23.

1.02  RELATED SECTIONS

A. Tile Backer Board: Section 09 30 00.
B. Wood Veneer Paneling: Section 06 20 00.
C. Acoustical Insulation: Section 07 21 00.

1.03  QUALITY ASSURANCE

B. Metal Framing System: Comply with ASTM C754 "Installation of Steel Framing Members to Receive Screw Attached Gypsum", and as specified.
C. Reference Standards: Wherever the following abbreviations are used herein they shall refer to the corresponding standard:
   2. GA: Gypsum Association.
D. Fire-Rated Construction: Comply with fire resistance ratings indicated on drawings and required by governing authorities and codes. Provide materials, accessories and application procedures that have been listed by Underwriters Laboratories or tested in accordance with ASTM E119 for the type of construction shown.
E. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to the tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by independent testing agency.
F. Guarantee: Submit written guarantee stating that cracks, delaminations or other imperfections in the drywall work which may develop within a period of 2 years from date of acceptance will be repaired at no cost to the Owner.

1.04 SUBMITTALS

A. Submit manufacturer's product data and installation instructions for each gypsum board system component.

B. Submit manufacturer's certification that fire-rated assemblies proposed meet project requirements, including evidence of approved test reports acceptable to governing building code enforcing authorities, that assemblies when installed with proposed materials, will meet or exceed fire ratings required.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened labeled containers.

B. Store, protect and handle materials in accordance with manufacturer's recommendations to prevent damage, soiling and deterioration. Protect cold-formed metal framing from corrosion, deformation and other damage during delivery, storage and handling per requirements of AISI's “Code of Standard Practice”. Protect adjoining surfaces against damage and soiling.

1.06 JOB CONDITIONS

A. Coordinate installation sequencing with work of other trades.
   1. Verify completion of other work, including that of other trades, which will be concealed by gypsum drywall construction before installation of wallboard.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Gypsum Board: U.S. GYPSUM CO.; GEORGIA-PACIFIC CORP.; NATIONAL GYPSUM COMPANY; CONTINENTAL BUILDING PRODUCTS; CERTAINTEED

B. Studs, Framing and Furring: CLARK DIETRICH BUILDING SYSTEMS; MARINO/WARE; STATE BUILDING PRODUCTS; gypsum board manufacturers listed above. Others as listed for specific products.

2.02 STEEL STUDS

A. Type: Screw type "C" shape, roll formed sheet steel members conforming to requirements of ASTM C645.
   1. Material: ASTM A653 steel with minimum yield strength of 33 ksi.
   3. Gage and Width – 3-5/8" to 6" Studs
      a. 22 gage x 3-5/8": Up to and including 14'-6" high.
      b. 20 gage x 3-5/8"
1) Over 14'-6" up to and including 16'-5" high
2) At wall mounted cabinet locations
3) At walls receiving ceramic tile
   c. 20 gage x 4": Over 16'-5" up to and including 17'-6" high
   d. 20 gage x 6": Over 17'-6" up to and including 24'-0"
   e. 16 gage at door jambs, heavy equipment locations, and interior partitions receiving masonry veneer.
   f. Provide other gages or widths as indicated on drawings.
4. Gage and Width – 1-5/8" to 2-1/2" Studs
   a. 22 gage x 1-5/8": Maximum height 8'-4"
   b. 20 gage x 1-5/8": Maximum height 9'-8"
   c. 22 gage x 2-1/2": Maximum height 11'-3"
   a. 20 gage x 2-1/2": Maximum height 12'-10"
5. Flange Width: Nominal 1-1/4".

B. Runners and Tracks: Designed and sized to receive studs. Gage to match studs except deflection tracks.
   1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; 20 gage thickness and in width to accommodate depth of studs. Provide one of the following:
      a. #53 FlexTrack, 20 gage typical, by SUPERIOR Metal Trim Products
      b. 20 gage top track with 2" minimum legs and 20 gage Spazzer 9200 Stud Spacer Bar by CLARK DIETRICH BUILDING SYSTEMS
      c. Slip Track (Slp Trk) by BRADY CONSTRUCTION INOVATIONS
      d. The System by METAL-LITE
      e. The Three Legged Dog by FLEX-ABILITY CONCEPTS.
      f. A double slip track, 20 gage, can be used in lieu of the deflection tracks specified above. Legs of tracks shall be minimum 2".
   2. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; 20 gage thickness and in width to accommodate depth of studs. Provide one of the following:
      a. Fire Trak System by FIRE TRAK CORPORATION.
      b. Flame Safe FlowTrak System by GRACE Construction Products.
      C. The system by METAL-LITE INC.

C. Backing Plates (Blocking): Steel sheet for blocking; width to fit framing spacing; height to be 6" unless otherwise indicated; base metal thickness: 0.0598" min.

D. Shaftwall Framing
   1. Provide "C-H" studs, "E" studs and "J" runners of sizes required for indicated heights and fire ratings.
      a. Unless otherwise shown, provide 4" deep studs, 22 gage up to 13'-0" high, 20 gage up to 14'-6" high.
      b. J-Runner at elevator entrances to be not less than 20 gage with long leg 3" wide.
   2. Track/runners to be of same gage as studs except minimum to be 24 gage.
   3. Roll-formed sheet steel members conforming to requirements of ASTM A653, minimum yield strength 33 ksi except C-H studs 40 ksi. Finish coating to be hot-dipped galvanized conforming to minimum, G-60 coating.
E. Special Corner Plates: 20 gage galvanized sheet metal break metal; 5" x 5" x continuous length; one-piece. Provide at corner where studs cannot fill corners (i.e. 60 degrees corners, etc.).

2.03 CEILING/SOFFIT SUSPENSION SYSTEM

A. Provide the following materials unless otherwise indicated on the drawings. Metals used in exterior or areas subjected to moisture to be hot-dipped galvanized in accordance with ASTM A653 or A123 as applicable.

1. Main Runners: Cold-rolled steel channels; not less than 16 gage; G-90 galvanized finish for exterior and moist areas, black asphaltum painted for other areas. Spacing as required, but not to exceed 48” o.c.
   a. 1-1/2" deep where structural support framing is at 48" o.c. or less.
   b. 2" deep where structural support framing is between 48" - 66" o.c.

2. Cross Furring
   a. Cold-rolled steel channels, not less than 16-gage; 3/4" size; same finish as main runners.
   c. 2-1/2" x 20-gage, G-60 galvanized steel studs. Provide for multiple layer applications, and 12” long nested studs at suspension points.

   a. Tie Wire: Minimum 16-gage.

B. Optional Framing: At contractor's option, proprietary furring system may be used in lieu of black iron system for dry interior conditions without fire-rated requirements.

1. Description: System consisting of furring runners, furring tees, cross tees and hanger wires, designed and manufactured specifically for suspending gypsum board ceiling.
   a. Non-fire rated.
   b. Electrogalvanized, cold-rolled steel, 0.020" thick.
   c. Double web members; 1-1/2" high with 1-3/8" capped face.

2. Manufacturer: 640 System by CHICAGO METALLIC CORP.; Drywall Suspension System by USG, WORTHINGTON STEEL COMPANY, Watercheck CONTINENTAL BUILDING PRODUCTS.


2.04 METAL FURRING

A. Type: Galvanized steel, hat-section channel, unless otherwise indicated; 7/8" furring depth by 1-1/4" face width. Provide Z-shape furring where indicated or required for walls in conjunction with thermal insulation. Thickness to match insulation


2.05 GYPSUM BOARD

A. General: Comply with ASTM C1396.
B. Fire Rated Gypsum Wallboard: Type “C” or "X" (special fire retardant) to meet fire ratings for construction shown; tapered edges. Thickness 5/8" unless otherwise indicated. Use at all locations indicated as meeting a specific fire resistance rating.
   1. Provide 5/8", Type X board at locations not indicating a specific type board.

C. Moisture and Mold Resistant Gypsum Wallboard
   1. ASTM C1396 (Section 5), Type X.
   2. Edges: Tapered.
   3. Thickness: 5/8 inch, unless otherwise indicated.
   4. Acceptable products: Mold Tough and Mold Tough Firecode (Type X) by USG; XP and XP Fire-Shield by NATIONAL; ToughRock and ToughRock Type X by GEORGIA-PACIFIC; Mold Defense and Mold Defense Type X by CONTINENTAL BUILDING PRODUCTS or equal by other gypsum board manufacturers listed in 2.01A.
   5. Water Absorption: ASTM C473, the average water absorption for panels is not greater than 5 percent by weight after two-hour immersion.
   7. Use on non-ceramic tiled walls, ceilings and soffits in toilet rooms, shower rooms and drying rooms; on ceramic tiled non-wet walls in toilet rooms; walls and partitions above ceilings

D. Moisture and Mold Resistant, Glass-Mat Gypsum Wallboard:
   1. ASTM C1396 (Section 5) and applicable sections ASTM C1658.
   2. Type X. Edges: Tapered.
   4. Acceptable products: Basis of design is e²XP Interior Extreme by National Gypsum. Other acceptable product include DensArmor Plus Firecode (Type X) by GEORGIA-PACIFIC or equal by other gypsum board manufacturers listed in 2.01A.
   5. Water Absorption: ASTM C473, the average water absorption for panels is not greater than 5 percent by weight after two-hour immersion.
   7. Use on non-ceramic tiled walls, ceilings and soffits in toilet rooms, shower rooms and drying rooms; on ceramic tiled non-wet walls in toilet rooms; walls and partitions above ceilings

   1. Thickness: ½” exterior and 5/8” interior; unless otherwise indicated.
   2. Roof Parapets: Where used as roofing substrate, provide high density, water repellent treated core with fiberglass mat and specifically designed for roofing membrane adhesion. Dens-Deck Prime Roof Board by GEORGIA-PACIFIC, or equal by above manufacturers.
F. Exterior Ceiling and Soffit Board: Tapered edges, 5/8" thickness unless otherwise indicated. Water resistant gypsum core and treated paper facing to withstand effects of moisture penetration. ASTM C931. Use for only horizontal out of weather applications (exterior soffits and ceilings).

G. Impact Resistant Gypsum Wallboard: ASTM C1396 and ASTM C1629, manufactured to produce greater resistance to surface indentation and through-penetration than standard gypsum panels; long edges tapered; where indicated.  
2. Minimum Physical Properties:  
   b. Type X.  
   c. Mold Resistance: minimum score of 10 per ASTM D3273  
3. Manufacturers: Mold Tough VHI by USG, Hi-Impact XP by NATIONAL GYPSUM COMPANY, Dens-Armor Impact by GEORGIA PACIFIC, Protecta HIR 300 by CONTINENTAL BUILDING PRODUCTS or equal by other gypsum board manufacturers listed in 2.01A.

H. Mold Resistant Gypsum Shaftliner Board: ASTM C1396, Type X, 1" thick gypsum core with mold resistant core and faces and chamfered edges.

I. Tile Backer Board: See Section 09 30 00.

J. Curved Walls - Interior: Provide ¼" Flexible Board where required. Meet all indicated fire ratings. Provide multiple plies to achieve thicknesses indicated. Stagger joints of adjacent plies.

2.06 ACCESSORIES

A. Fasteners: Drywall screws and metal framing screws per manufacturer's instructions and recommendations for type and size, based on construction and conditions involved.  
1. Steel Drill Screws: ASTM C1002.  
2. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

B. Trim: ASTM C1047.  
1. Manufacturers  
   a. Metal: BEADEX MANUFACTURING; CLARK DIETRICH BUILDING SYSTEMS; listed gypsum board manufacturers  
   b. Vinyl: VINYL TECH; VINYL CORP.; TRIM TEX  
2. Corner Beads - Outside, Square Corners: 1-1/4 inch x 1-1/4 inch heavy gauge galvanized steel or vinyl, perforated.  
3. Corner Beads - Outside, Non-square Corners: BEADEX B-1 Splay Flexible Corner or equal. Concealed metal; two galvanized continuous strips laminated with paper trim; for application without mechanical fasteners.  
4. Curved Edge Cornerbead: Notched or flexible edge.  
5. Exposed Edges (Casing Beads): L-bead or LC-bead; exposed long flange receives joint compound. Size to suit wallboard. J-shaped bead that does not receive joint compound is not permitted.
6. Expansion (Control) Joints: Tape protected 1/4" wide x nominal 7/16" deep control slot.

C. Joint Treatment Materials: ASTM C475.
   1. Joint Tape. Width to adequately cover joint.
      c. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
   2. Joint Taping Compound: Designed for bonding tape to wallboard and coating corner beads and fasteners.
      a. Exterior Exposure: Type as recommended by board manufacturer.
   3. Joint Topping Compound: Designed to sand smooth and feather well for finished surface. Type as recommended by board manufacturer.
      a. Exterior Exposure: Type as recommended by board manufacturer.

D. Additional Item: All additional accessories to complete work including nails and anchors to secure frames to walls and floors.

E. Reveal Trim Beads: Aluminum, Softforms STR-050-050 by PITTCON, FRY or GORDON.

F. Acoustic Materials
   1. Insulation: See Section 07 21 00; Sealant: See Section 07 92 00.

PART 3  EXECUTION

3.01 PREPARATION
   A. Maintain uniform building temperature range not less than 55 degrees F., for 24 hours before, during, after gypsum panel installation and joint finishing treatment.
   B. Provide adequate lighting and ventilation during installation and joint finishing.

3.02 INSPECTION
   A. Examine substrates and installation conditions. Do not proceed with gypsum wallboard work until unsatisfactory conditions have been corrected.
      1. Protrusions of framing, twisted framing members, or unaligned members must be repaired before installation of wallboard is started.
   B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.03 FRAMING INSTALLATION
   A. Comply with the requirements of ASTM C754 "Installation of Steel Framing Members to Receive Screw Attached Gypsum", and as specified.
   B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except
where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. **Slip-Type Head Joints:** Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. **Rated Stud Deflection Assembly:** Install in accordance with manufacturer's instructions to provide required fire ratings. Ensure that anchoring devices, back-up material, clip supports and other materials are as used in referenced fire tests.
3. **Securely attach runner to floor with expansion anchors or equivalent.**

C. **Install all framing plumb and square with spacing as indicated.**

D. **Provide supplementary framing, blocking and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings or similar construction. Comply with details indicated, recommendations of gypsum board manufacturer or if none available with United States Gypsum Company’s “Gypsum Construction Handbook.”**

E. **Bridging**
   1. **Up to 10 ft. Wall Height:** 1 row.
   2. **10 ft. and Over Wall Height:** 2 rows of bridging.

F. **Provide a minimum of two (2) screws per connection.**

G. **Curved Partitions**
   1. **Bend track to uniform curve and locate straight lengths so they are tangent to arcs.**
   2. **Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.**

H. **Shaftwall Framing**
   1. **Install "J" runners, "C-H" studs, "E" studs and 1" gypsum liner panels in accordance with manufacturer's recommendations and drawings.**
   2. **Include additional bracing and blocking as required support of recessed or applied items.**
   3. **Provide all openings in shaftwall in a manner consistent with shaftwall system manufacturer’s published details with approval by the Architect and as required to maintain fire rating integrity of assembly.**

3.04 **FURRING INSTALLATION**

A. **Wall Application**
   1. **Attach to masonry with expansion anchors or at mortar joints with concrete nails or expansion anchors.**
   2. **Spacing shall be 16 in. o.c., unless otherwise indicated.**
   3. **Run vertically or horizontally for maximum efficiency.**

B. **Ceiling Application:** Install suspension system for ceilings and soffits, both interior and exterior, in accordance with manufacturer's instructions, recommendations and
as follows:

1. Locate furring runners at 48” on center with hanger wires at 48” on center. Attach hanger wires to structural framing members specifically for this purpose. Attach hanger wires to framing wires using attachment devices whose suitability has been demonstrated by standard construction practice or by certified test data.

2. Connect furring runners with furring tees spaced at 24” on center. Locate additional tees or hanger support as required for surface mounted and recessed ceiling and soffit items such as light fixtures, diffusers, etc. Add additional hanger wires as required to support all items at each corner.

3. Provide wall track wherever suspension meets a vertical surface.

4. Brace suspension system for exterior ceilings and soffits to structure above to resist wind up-lift using metal channels or metal studs. Install after system is completely suspended to level plane.

5. Do not support ceiling system from ductwork, electrical conduit, heating or plumbing lines, and vice versa. Each utility system and the ceiling system shall be a separate installation and each shall be independently supported from the building structure.
   a. If an interference occurs, provide trapeze type hangers or other suitable supports for each system. Locate hangers where they will not interfere with access to mixing boxes, fire dampers, valves and other appurtenances requiring servicing.
   b. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.05 GYPSUM BOARD INSTALLATION


B. General: Do not proceed with gypsum board installation until blocking, framing, bracing and other supports for subsequently applied work have been installed, reviewed and accepted by the Architect. Do not install gypsum board until work concealed by gypsum board has been installed.

C. Application
   1. Install gypsum board face side out. Do not install imperfect, damaged or damp boards.
   2. Butt boards together for a light contact at edges and ends with not more than 1/16” open space between boards. Do not force into place.
   3. Locate either edges or end joints over supports. Position boards so that both tapered edge joints abut. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.
   4. Attach gypsum board to framing and blocking as required for additional support at openings and cutouts.
   5. Floating Construction: Install gypsum board with "floating" internal corner construction, unless isolation of the intersecting board is indicated.
   6. In addition to compliance with the standards, comply with specific
requirements indicated for each type of arrangement of gypsum wallboard system shown. Space fasteners in accordance with manufacturer's recommendations and complying with referenced standards.

a. Walls and Partitions: Apply sheets horizontally or vertically. Provide maximum sheet lengths to minimize end joints with edges or ends over supports. In two layer applications, stagger joints of second layer from joints of first layer.

b. Cut and install panels to eliminate vertical joints in corners of door frames to ceiling.

c. Make cutouts to fit within wall plate, register and grille flanged. All cutouts made by knife or saw.

d. Make angles and corners clean, true, plumb and square; walls plumb, flat and straight and ceilings flat and level.

e. Ceilings: Apply gypsum board on ceilings, before application on walls and partitions. Install in direction and manner to minimize end joints. Stagger end joints over supports. In two layer applications, stagger joints of second layer from joints of first layer.

D. Direct-Glue Application

1. Apply gypsum vertically with closely butted joints within 10 minutes after application of mastic adhesive, sooner if recommended by manufacturer. Apply firm pressure over entire board to effect a bond and to level board. Use slight sliding movement to position board. Shim drywall 1/4" off floor.

2. Apply mastic adhesive in amounts and at locations on board as recommended by adhesive manufacturer. Provide temporary fasteners or bracing as recommended until adhesive sets.

E. Exterior Ceiling and Soffit Board

1. Install exterior ceiling and soffit board perpendicular to supports, stagger end joints over supports, use maximum lengths possible to minimize joints.

2. Install with 1/4 inch open space where boards abut other work.

3. Space screws 4" o.c. around perimeter of board and 8" o.c. on intermediate framing members and on diagonal braces. Locate fasteners minimum 3/8 inches from edges and ends of sheathing panels. Drive fasteners to bear tight against and flush with sheathing surface. Do not countersink.

4. Provide trim at all perimeter edges.

5. Apply sealant around sheathing perimeter at interface with other materials.

3.06 EXTERIOR SHEATHING AND SOFFIT BOARD

A. Comply with GA-253 and with manufacturer's written instructions.

1. Install exterior sheathing board perpendicular to supports, stagger end joints over supports, use maximum lengths possible to minimize joints.

2. Install with 1/4 inch open space where boards abut other work.

3. Space screws 4" o.c. around perimeter of board and 8" o.c. on intermediate framing members and on diagonal braces. Locate fasteners minimum 3/8 inches from edges and ends of sheathing panels. Drive fasteners to bear tight against and flush with sheathing surface. Do not countersink.

4. Apply sealant around sheathing perimeter at interface with other materials.

5. Board Joints: Provide seam sealing tape or joint sealant at Contractor's option, as follows:
a. Seam Sealing Tape
   1) Apply primer to joints and fasteners, allow to dry.
   2) Seal joints using tape specified herein or other similar type method recommended by board manufacturers for application indicated. Apply at time of sheathing, to sealed, dry, dust-free joints. Apply seam sealing tape along all edges, overlapping at intersections by width of tape.
   3) Apply sealant to exposed fasteners with a trowel so fasteners are completely covered.
   4) Seal other penetrations and openings.
   5) Coordinate sheathing and placement of through-wall flashing. Tape top of through-wall sealant to sheathing to provide a water-tight joint.

b. Sealant
   1) Apply minimum 3/8" bead of sealant to joints and trowel to provide a layer approximately 2" wide by 1/16" thick spanning the joint. Apply enough to each fastener to cover completely when troweled flat. Use backer rod for openings larger than 1/8".
   2) Apply sealant to exposed fasteners with a trowel so fasteners are completely covered.
   3) Seal other penetrations and openings.
   4) Coordinate sheathing and placement of through-wall flashing. Tape top of through-wall flashing to sheathing to provide a water-tight joint.

3.07 INSTALLATION OF SOUND RATED PARTITIONS

A. Provide sound-rated construction where indicated.

B. Acoustic Insulation: Install single layer of acoustic batt insulation in designated partitions after one side of gypsum board is installed, filling width and height of partition completely. Attach to gypsum board with adhesive spots to prevent subsequent displacement.

C. Extend partition stud system through acoustical ceilings to substrate. Apply gypsum board base panels full height, both sides of partition.

D. Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

E. Seal partition perimeters. Provide continuous beads of acoustical sealant at juncture of both faces of runners or plates with floor and ceiling construction and wherever work abuts dissimilar materials. Seal prior to installation of sound attenuation insulation and gypsum board panels.

F. Provide continuous beads of sealant at juncture of gypsum board and abutting
surface. Install gypsum board with 1/8" relief for sealant. Sealants to be contained within depth of gypsum board, not as a fillet.

G. At openings and cutouts, fill open spaces between edges of gypsum board and fixtures, cabinets, ducts, and other flush or penetrating items, with continuous bead of acoustical sealant.

H. If sound-rated partitions intersect non-sound-rated partitions, extend sound construction to completely close-off sound flanking paths through non-rated construction. Seal joints between face layers at vertical interior angles of intersecting partitions.

I. Exercise particular care at walls surrounding toilet areas and walls and ceilings surrounding mechanical spaces to provide properly constructed sound-rated gypsum board partition and ceiling systems.

J. Verify that electrical boxes are not located back-to-back; back-to back boxes to be offset at least one stud space. Do not close off non-complying conditions before notifying and receiving direction from Architect.

3.08 TRIM AND ACCESSORIES

A. Install corner beads at external corners of gypsum wallboard and sheathing work. Use longest practical lengths.

B. Install edge trim wherever edge of gypsum board or sheathing would be exposed or semi-exposed.
   1. Provide beaded trim to receive joint compound at all wallboard work.
   2. Provide L-type trim where work is abutted to other work and Kerf-type where work is kerfed to receive kerf leg.
   3. Provide U-type trim where edge is exposed, revealed, gasketed or sealant filled, including expansion joints.

C. Attach to framing with steel screws. Clinch attachment to wallboard not acceptable.

D. Control Joints
   1. Install control joints to isolate gypsum board surfaces as recommended by ASTM C840. Verify locations with Architect prior to installation. Generally locate joints as follows when:
      a. Partition, furring or column fireproofing abuts a structural element (except floor) or dissimilar wall or ceiling.
      b. Ceiling abuts a structural element, dissimilar wall or partition or other vertical penetration.
      c. Construction changes within the plane of the partition or ceiling.
      d. Partition or furring run exceeds 30'.
      e. Ceiling dimensions exceed 50' in either direction with perimeter relief; 30' without relief.
      f. Exterior ceilings and soffits exceed 20' in either direction; align with window mullions, when applicable.
      g. Wings of "L", "U", and "T"-shaped ceiling areas are joined.
      h. Expansion or control joints occur in the base exterior wall.
i. Differential Deflection Conditions: All locations where partitions are supported by two or more structural members and subject to differential deflection by live or dead loading:
   1) Typical Framing Floor to Structure: Provide "Ceiling Deflection Track".
   2) Framing over One Floor (stairs, shafts, etc.): Provide control joints where studs are interrupted by structure.

j. Partition terminations at window mullions.
   1) Neoprene joint tape / caulking installed in Section 07 92 00.
   2) Aluminum mullion closures provided under Section 08 41 13

2. Provide framing immediately on both sides of joint and back with 2"+/- gypsum board strips as required to maintain fire resistance rating.

3.09 FINISHING

A. Comply with manufacturer's instructions for mixing, handling and application of materials. Apply treatment at joints both directions, at flanges of trim accessories, penetrations of gypsum board (electrical boxes, piping and similar work), fastener heads, surface defects and elsewhere indicated. Apply in manner that will result in each item being concealed when applied decoration has been completed.

B. Prefill open joints of more than 1/16" with special chemical-hardening type bedding compound, before bedding joint tape.

C. Apply joint tape at joints between boards, except where trim accessories indicated

D. Do not use topping compound for bedding joint tape.

E. Apply joint compound for the final coat of joint treatment, unless specifically recommended by the manufacturer for that use.

F. Walls Above Acoustical Ceiling Systems: Tape and fill joints with two coats of joint compound, sanding not required.

G. Leave all exposed surfaces smooth and even, ready for painting.

H. Provide where indicated on the drawings levels of finish as specified in ASTM C840, "Recommended Specification on Levels of Gypsum Board Finish". 
   **Finishes / Uses in accordance with GA-214 Levels of Finish.** 
   Coordinate the drywall level of finish with the proposed interior finish as outlined in the Finish Schedule. Unless otherwise indicated on drawings, use Level 2 if building interior is to remain unfinished for more than thirty (30) calendar days from proposed interior build-out. Verify with Owner / Landlord and Tenant(s) regarding extent of work and required finish on demising walls, renovated surfaces and other sheathing during shell construction:
   **Level 0:** No taping, finishing or accessories. **Use in** temporary construction; or where final wall finish has not been determined in scope of work.
   **Level 1:** All joints / interior angles are taped set in joint compound; drywall surface to be free of excess compound. Accessories are optional dependent upon potential for public view. **Use in** areas of non-public view and in above ceiling areas such as plenums. May be considered.
a “fire-tape” level if approved by local Authority Having Jurisdiction.

**Level 2:** All joints / interior angles are taped set in joint compound; drywall surface to be free of excess compound. Accessories, fastener heads and tape to be covered with a coat of compound. Use for M/R tile substrate; and where surface appearance is not a primary concern, such as garages, storage areas, or where drywall may be a substrate for a future finish.

**Level 3:** All joints / interior angles are taped set in joint compound, with a one coat cover; drywall surface to be free of excess compound. Accessories and fastener heads to have two coats of compound. Smooth all coats free of tool marks and ridges. Prepare surface with drywall primer prior to the application of the design finish. Use for walls exposed to view where heavy/medium texture finishes are applied prior to painting, or where heavy-grade wallcovering applied

**Level 4:** All joints / interior angles are taped set in joint compound, with a one coat cover over angles & two coat cover for joints; drywall surface to be free of excess compound. Accessories and fastener heads to have three coats of compound. Smooth all coats free of tool marks and ridges. Prepare surface with drywall primer prior to application of design finish. Use for walls exposed to view where flat paints, light textures / wallcoverings & eggshell / satin paints are used: and some drywall ceiling applications.

**Level 5:** All joints / interior angles are taped set in joint compound, with a one coat cover over angles & a two coat cover for joints; drywall surface to be free of excess compound. Accessories and fastener heads to have three coats of compound. Smooth all coats free of tool marks and ridges. A final skim coat is to be applied over the entire surface. Prepare surface with drywall primer prior to the application of the design finish. Use for walls exposed to view where gloss, semi-gloss enamel or non-textured flat paints are specified; or, where severe lighting conditions occur.

### 3.10 ADJUST AND CLEAN

A. Remove any screw which does not engage into a framing member or spins freely.

B. When paper face is punctured, drive new screw approximately 1-1/2" from defective fastener and remove fastener. Fill damaged surface with compound.

C. Ridging: do not repair ridging until condition has fully developed: approximately 6 months after installation or one heating season. Sand ridges to reinforcing tape without cutting through tape. Fill concave areas on both sides of ridge with topping compound. After fill is dry, blend in topping compound over repaired area.

D. Fill cracks with compound and finish smooth and flush.

E. Remove and replace panels that are wet, moisture damaged, and mold damaged. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface
contamination and discoloration.

3.11 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

END OF SECTION
SECTION 09 30 00

TILE

PART 1  GENERAL

1.01  WORK INCLUDED

A.  Extent of tile work is shown on drawings and schedules, and as specified herein.

B.  Types of tile work required including the following:
   1.  Quarry tile floor and base.
   2.  Ceramic wall tile, floor tile and base.
   3.  Porcelain wall tile, floor tile and base.
   4.  Slate tile.
   5.  Backer board.
   6.  Marble shower basin.

C.  Section also includes:
   1.  Stone thresholds installed as part of tile installations.
   2.  Crack-suppression membrane for thin-set tile installations.
   3.  Metal edge/transition strips installed as part of tile installations.
   4.  Stair nosings installed as part of the tile installations.

1.02  RELATED SECTIONS

A.  Sustainable Design Requirements:  Section 01 81 13.

B.  Sealant:  Section 07 92 00.

C.  Concrete slab preparation:  Section 01 73 00.

1.03  QUALITY ASSURANCE

A.  Manufacturer:  Provide tile of each type produced by a single manufacturer.
    Provide materials obtained from one source for each type and color of tile, grout,
    and setting materials.

B.  Installer:  A firm with not less than 5 years experience in installing tile in
    applications similar to those required for this work.

C.  Ceramic Tile Manufacturing Standard:  TCA 137.1.  Furnish tile complying with
    Standard Grade requirements unless indicated otherwise.

D.  Proprietary Materials:  Handle, store, mix and apply proprietary setting and grouting
    materials in compliance with manufacturer's instructions.

E.  Installer to verify locations of all flexible joints required by the provisions of this
    section, by the recommendations of TCA, and by the recommendations of the
    related manufacturers. See Article 3.06.
    1.  Joint locations may or may not be indicated on the drawings.
1.04 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction: For tile installed on walkway surfaces subject to traffic while wet, provide products with a dynamic coefficient of friction not less than 0.42 as determined by testing identical products per ANSI A137.1.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical information and installation instructions for materials required. Include certifications and other data to show compliance with these specifications.

B. Special Environmental Requirements: Submit the following in accordance with Section 01 81 13:
   1. Product Data: For adhesives and epoxy, documentation indicating VOC Content

C. [Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.]

D. Samples: Submit manufacturer's color charts consisting of actual tiles or sections of tiles showing full range of colors available, for each type of tile specified. Include samples of grout and accessories requiring color selection. Submit full size sample for each type of trim, accessory and color. Submit samples of metal edge strip.

E. Certification: Furnish Master Grade Certificate for each type of tile, signed by manufacturer and Installer.

1.06 PRODUCT HANDLING

A. Deliver packaged materials and store in original containers with seals unbroken and labels intact until time of use, in accordance with manufacturer's instructions.

1.07 JOB CONDITIONS

A. Maintain environmental conditions and protect work during and after installation in accordance with referenced standards and manufacturer's printed recommendations.

PART 2 PRODUCTS

2.01 QUARRY TILE

A. Quarry Floor Tile: 1/2" thick, cushion-edged standard grade quarry tile conforming to ANSI 137.1. Colors as selected by Architect from manufacturer's full range of colors.
   1. Sizes: As indicated.
   2. Base: Where quarry tile base is scheduled provide 6" high, 1/2" thick quarry tile cove base with rounded bullnose top. Base pieces to be 6" long to match tile. Provide inside and outside corners and trim pieces as
required. Color to match floor quarry tile.

3. Manufacturer: Provide quarry tile and base as manufactured by one of the following subject to the above requirements:
   a. AMERICAN OLEAN TILE.
   b. DAL-TILE CORPORATION.
   c. SUMMITVILLE TILES, INC.

2.02 CERAMIC TILE

A. Ceramic Wall and Floor Tile: Standard grade, impervious porcelain ceramic tile conforming to ANSI 137.1. Provide trim pieces as required.

1. Walls: [2" x 2"] [4" x 4"], glazed.
   a. Colors: Minimum of 2 colors per room will be used.
   b. Color Layout (Patterns): As indicated or as directed by Architect.

2. Floors: [1" x 1"] [2" x 2"], unglazed.
   a. Colors: Minimum of 2 colors per room will be used.
   b. Color Layout (Patterns): As indicated or as directed by Architect.

3. Base: Provide [1"] [2"] [4"] high, porcelain ceramic tile, cove base with [square top, for meeting wall tile] [and] [bullnose top at terminations]. Base pieces to be of length to match wall tile, or multiples of wall tile. Provide inside and outside corners and trim pieces as required.
   a. Color and finish to match wall tile as selected by Architect.

4. Manufacturer: Provide ceramic floor tile, wall tile and base as manufactured by one of the following subject to the above requirements.
   a. BUCHTAL.
   b. AMERICAN OLEAN TILE.
   c. DAL-TILE CORPORATION.
   d. MID-STATE TILE COMPANY.
   e. MONARCH TILE COMPANY.

2.02 CERAMIC TILE

A. Ceramic Wall Tile, Floor Tile and Base: Standard grade, impervious porcelain ceramic tile conforming to ANSI 137.1. Provide trim pieces as required.

B. Manufacturer

1. Basis of Design: Colors indicated on the drawings are based on tiles manufactured by DAL-TILE CORPORATION.

2. Other Acceptable Manufacturers: Tile manufactured by the following companies are acceptable providing they meet the requirements specified herein and the colors are an acceptable match as determined by the Architect.
   a. BUCHTAL.
   b. AMERICAN OLEAN TILE.
   c. DAL-TILE CORPORATION.
   d. MID-STATE TILE COMPANY.
   e. MONARCH TILE COMPANY.
   f. LATCO

2.02 CERAMIC TILE

A. Ceramic Wall Tile, Floor Tile and Base: Standard grade, impervious porcelain ceramic tile conforming to ANSI 137.1. Provide trim pieces as required.
1. Basis of Design: Manufacturer, Styles and Colors: As indicated on the drawings.

2. Other Acceptable Manufacturers: Ceramic tile manufactured by other manufacturers will be considered if materials meet the requirements of the Basis of Design and the sizes and colors are an acceptable match as approved by the Architect prior to bid opening. These additionally approved manufacturers will be included by Addendum. An unacceptable pattern or color match is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.

2.03 SLATE FLOORING

A. Floor Tiles: 12" x 12" x 1/2" thick, sawed edges.

B. Faces
   1. Exposed (Wearing Surface): Natural cleft.
   2. Bonding Face: Gaged.

C. Colors: Two required. Gray and black as selected by Architect.

D. Manufacturer: BUCKINGHAM-VIRGINIA SLATE CORPORATION or equal.

2.04 MORTAR, GROUT AND ACCESSORIES

A. See Tile Installation Systems in Part 3 of this Section. Setting mortar and grout to be from same manufacturer.

B. General - All Adhesives, Grouts and Epoxies: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the current VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule #1168; VOC limits effective July 1, 2005 and rule amendment date of January 7, 2005.

C. Modified Dry Set Cement Mortar - Thin Set: Factory mixed mortar of Portland cement/sand, field gauged with undiluted latex admixture. Conform to ANSI A118.4, Latex-Portland Cement Mortar. Provide type suitable for “medium-set” for tiles with a dimension larger than 15”.
   1. Provide one of the following:
      a. BOSTIK, Durabond D-50 or D-60.
      b. MAPEI, Ultraflex 3.
      d. LATICRETE, 255 MultiMax.

D. Dry-Set Mortar - Thin Set: Mixture of Portland cement with sand and latex, water imparting additive. Conform to ANSI A118.1, Standard Dry-Set Cement Mortar.
   1. May be used in lieu of Modified Dry Set Cement Mortar for ceramic floor and wall tile.

E. Portland Cement Setting Mortar - Thick Set (ANSI 108.2): Provide waterproof membrane beneath floor setting beds. Provide cleavage membrane at floors without waterproofing membrane. Reinforce floor setting beds. Provide bed of a thickness as required to bring the tile to the required finish elevation as shown on
the drawings. Provide materials as follows:
1. Underbed: Mix 1 part Portland cement to 5 parts loose, damp sand by volume.
   b. Sand: ASTM C144.
   c. Water: Clean, potable and free of deleterious substances.
2. Membrane Waterproofing: See Membrane Waterproofing herein

F. Grout - Ceramic Tile (ANSI A118.7): Integrally colored, sanded (unless otherwise indicated), polymer modified cement type, factory prepared (premixed) grout. Color as selected by Architect.
   1. Provide one of the following:
      a. BOSTIC, Ceramic Tile Grout with BOSTIK 425 Acrylic-Latex Admixture.
      b. TEC (H.B. FULLER), TEC Power Grout.
      c. MAPEI, Ultracolor.
      d. LATICRETE, Permacolor Grout.
   2. Colors: As selected by Architect.
   3. Provide unsanded grout for glass tile and tile joints less than 1/8" wide.

   1. Bond Coat: Two-component epoxy grout complying with ANSI A118.3. See manufacturers under "Grout for Floors and Base."
   2. Grout for Floors and Base: Multi-component epoxy grout complying with ANSI A118.3. Color as selected by Architect. Provide one of the following:
      a. BOSTIC, U-poxy/AAR II.
      b. MAPEI, Kerapoxy.
      c. LATICRETE, Latapoxy SP-100.
      d. TEC (H.B. FULLER).

H. Membrane Waterproofing: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
      a. Products: Provide one of the following:
         1) BONSAL AMERICAN; B 6000 Waterproof Membrane with Glass Fabric
         2) BOSTIK, INC.; Hydroment Blacktop 90210.
         3) LATICRETE INTERNATIONAL, INC.; Laticrete 9235 Waterproof Membrane.
         4) MAPEI CORPORATION; Mapelastic HPG with MAPEI Fiberglass Mesh.
   2. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer
      a. Products: Provide one of the following:
         1) BONSAL AMERICAN; B 6000 Waterproof Membrane.
2) BOSTIK, INC.; Hydroment Gold.
3) LATICRETE INTERNATIONAL, INC.; Latapoxy 24hr HydroProofing.
4) MAPEI CORPORATION; Mapelastic HPG.
5) TEC (H. B. FULLER COMPANY); HydraFlex - Waterproofing Crack Isolation Membrane

   1. Products: Provide one of the following:
      a. MAPEI CORPORATION; Mapelastic SM.
      b. NATIONAL APPLIED CONSTRUCTION PRODUCTS, INC.; Strataflex.
      c. POLYGUARD; Tileguard.

J. Metal Edge Trim: L-shape, height to match tile and setting-bed thickness; stainless steel, ASTM A666, 300 Series. SCHLUTER, CERAMIC TOOL COMPANY, BLANKE

[K. Marble Thresholds: Honed Italian marble, 3/8” thick x 4” wide minimum x width of door opening. Provide thresholds free from cracks, chips, stains or defects; uniform in tone and coloring. Provide double bevel profile. Color as selected by Architect.]

[K. Solid Surface Thresholds: Corian by DU PONT, AVONITE, FORMICA, Gibraltar by WILSONART. Color as selected by Architect from manufacturer's full range. Thickness as required for compliant threshold condition.]
   1. Surface burning characteristics in accordance with ASTM E 84: Class I or A, and as follows:
      a. Flame spread: <25.
      b. Smoke developed: <25.
   2. Edge Treatment: Ease all exposed edges.

L. Stair Nosing
   1. Description: Roll-formed brushed stainless steel type 304; self-adhesive, non-slip tread, 2-5/32 inch wide exposed surface with rounded leading edge, and integrated trapezoid-perforated anchoring leg.
   2. Tread Color: As selected by Architect.
   3. Height: As required to match tile thickness.
   4. Manufacturer: SCHLUTER TREP-G or equal by CERAMIC TOOL COMPANY, BLANKE.

M. Grout Sealer: Low VOC, penetrating type as recommended by grout manufacturer that does not change color or appearance of grout.

2.06 TILE BACKER BOARD

A. Description: Nominal 1/2” thick cementitious board with fiberglass mesh reinforcements conforming to the requirements of ANSI A118.9.
   1. Provide cadmium plated screws, type as recommended by board manufacturer.
2. Joint Treatment Tape: 2" wide, 10x10 glass mesh type or similar type as recommended by board manufacturer.

B. Manufacturer: Wonder Board by MODULARS, INC.; Util-A-Crete by FIN PAN; Durock Interior Tile Backer Board by U.S. GYPSUM; Dens-Shield by GEORGIA PACIFIC.

2.08 MARBLE SHOWER BASIN

A. Manufacturer/Description
1. Basis of Design: CENTURA MARBLE.
2. Other Manufacturers: ROMA MARBLE INC., VERONA MARBLE COMPANY.
3. Color: “Coffee”
4. Surface: Textured Surface throughout

B. Textured Shower Base sloping to Floor Drain. Basin shall be installed AFTER completion of Wall tile installation. See drawings for details.

C. Field verify conditions and dimensions prior to fabrication and installation

D. Provide complete shop drawings prior to fabrication and installation, along with color and texture sample.

PART 3  EXECUTION

3.01 INSPECTION

A. Examine surfaces to receive tile, setting beds and accessories before tile installation for the following:
1. Defects or conditions adversely affecting quality and execution of the installation.
2. Deviations beyond allowable tolerances of surfaces to receive tile.
3. Do not proceed with installation work until unsatisfactory conditions are corrected.

B. Conditions of surfaces to receive tile.
1. Surfaces to be firm, dry, clean, and free of oily or waxy films or curing compounds.
2. Grounds, anchors, plugs, hangers, bucks, electrical, plumbing and HVAC work in or behind tile to be installed prior to proceeding with tile work.

3.02 PREPARATION

A. Prepare surfaces to receive tile as required to achieve proper bond and as recommended by the Tile Council of America.
1. See Section 01 73 00 for additional floor preparation requirements.

B. Fill cracks, low areas and pits in concrete with self-leveling fill of type recommended by tile manufacturer for substrate conditions encountered.

C. Lightly grind concrete subfloors with a terrazzo grinder to remove trowel marks,
slab curl at saw cut joints or other surface irregularities or high spots which will telegraph to the flooring surface.

D. Sawcut or grind transition areas to install tile flush with adjacent finished floor materials.

E. Clean surfaces in a manner suitable for proper installation. Verify that slabs are free of curing membranes, oil, grease, wax, dust and other materials deleterious to tile installation.

F. Primers or other preparations required or recommended in accordance with manufacturer's instructions.

3.03 TILE BACKERBOARD

A. Location: Provide tile backerboard on metal stud walls as a substrate for ceramic tile products specified herein which are located [on shower walls] [on toilet room wet walls] [where indicated].

B. Install in strict accordance with manufacturer's recommendations and ANSI A108.11, Interior Installation of Cementitious Backer Units.
   1. Butt ends and edges of adjacent panels.
   2. Attach with screws spaced at 6 inch centers on perimeter and field.
      a. Maintain minimum 1/2 inch from screws to panel edge.
      b. At wainscot or similar location where tile terminates in same plane of wall, shim tile backerboard flush with adjacent wall board. Provide shims continuous along face of studs.
   3. Locate control and expansion joints in same locations as substrate and where required by wall tile.
   4. Apply glass mesh tape, or type recommended by board manufacturer, over joints. Embed tape in setting material indicated for specified tile finish.

3.04 INTERIOR WALL TILE INSTALLATION - SYSTEMS

A. Prepare surfaces, fit, set or bond, grout, and clean in accordance with Tile Council of America, "Handbook for Ceramic Tile Installation", 2011 Edition; and as follows:

C. Thin Set - Stud Walls - Over Tile Backerboard: TCA W244, dry-set mortar bond coat or latex Portland cement bond coat and grout.
   1. Tile: ANSI A108.5.
   3. Backerboard
      a. Joint Preparation: Fill joints completely with setting mortar and embed 2 inch wide coated fiberglass tape into skim coat of same mortar.
      b. Apply setting mortar in one layer, troweling skim coat with trowel's flat edge and then texturing with appropriate notched trowel. Troweling equipment must be appropriate for type of tile work and in good condition.

1. Tile: ANSI A108.5.

D. Thin Set - Solid Back-Up Walls (concrete, CMU, etc.): TCA W202, dry-set mortar bond coat or latex Portland cement bond coat and grout.
1. Tile: ANSI A108.5.

E. Thick Set - Solid Back-Up Walls (concrete, CMU, etc.) - Dry and Wet Areas: TCA W221, Portland cement mortar bed, metal lath, [waterproof membrane], dry-set mortar bond coat or latex Portland cement bond coat and grout.
3. Install mortar bed to thickness indicated on drawings.

3.05 INTERIOR FLOOR TILE INSTALLATION - SYSTEMS

A. Prepare surfaces, fit, set or bond, grout, and clean in accordance with Tile Council of America, "Handbook for Ceramic Tile Installation", 2011 Edition; and as follows:

B. Thick Set with Waterproof Membrane: TCA design F121; waterproof membrane, Portland cement mortar bed, reinforcing, bond coat and grout.
1. Tile: ANSI A108.1A.
3. Mortar Bed Thickness: As indicated (min. 1-1/4"; max. 2").
4. Wet areas; shower areas; drying areas; pool decks; other areas indicated.

C. Thick Set with Cleavage Membrane: TCA design F111, Portland cement mortar bed, dry-set mortar bond coat or latex Portland cement bond coat, cleavage membrane, reinforcing and grout.
1. Tile: ANSI A108.1A.
3. Mortar Bed Thickness: As indicated (min. 1-1/4"; max. 2").
4. Pool decks; other areas indicated.


1. Install in strict conformance with waterproofing membrane manufacturer's written instructions and recommendations.
2. Tile: ANSI A108.5.
4. Wet areas; shower areas; drying areas; other areas indicated.

F. Thin Set: TCA design F113, latex Portland cement mortar and grout or dry-set mortar and grout.
1. Tile: ANSI A108.5.

G. Epoxy Mortar and Grout: TCA design F131; epoxy mortar and grout. ANSI A108.6.
1. Quarry tile; kitchen areas; other areas indicated.


3.06 TILE INSTALLATION - PROCEDURES

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
   a. Floors in wet areas
   b. Swimming pool decks
   c. Kitchen areas
   d. Floor tiles 8” x 8” and larger
   e. Rib-backed floor tiles

B. Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars or covers overlap tile.

D. Placement Methods: Install tile using the hereinbefore specified setting beds and grouts.

E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting.
1. Avoid tile layout with less than half width tiles at room/area perimeters, unless otherwise indicated on the floor layout drawings. Notify Construction Manager if layout not achievable per layout indicated on the drawings. Do not continue in room/area in question until approved by the Associate.
2. Provide uniform joint widths, unless otherwise shown.
   a. Ceramic Mosaic Tile: 1/16 inch.
   b. Quarry Tile: 1/4 inch
   c. Large format Floor Tile: 1/8 inch.
   d. Glazed Wall Tile: 1/16 inch.

F. Anti-Fracture Membrane: Install over floor cracks, cold-joints and sawed joints.
Discontinue at expansion joints. Install in compliance with ANSI 108.17 and manufacturer’s instructions and recommendations. Seam joints as recommended by manufacturer. Conform to TCA F125. Coordinate with flexible joints specified in Article 3.07, Flexible Joints.

3.07 FLEXIBLE JOINTS

A. Locate flexible joints (expansion, control and isolation joints) prior to tile installation. See Quality Assurance in Part 1 herein.

B. Provide flexible joints as specified herein, unless more stringent requirements are indicated on drawings. Provide as specified, regardless if not indicated on drawings.

C. Joint to be continuous from face of tile to bottom of setting bed or leveling bed. Reinforcing to be discontinued at joint. Install continuous joint filler material in joint from setting or leveling bed to a point below face of tile adequate for proper placement of backing rod and sealant.

D. Joint Design: TCA design EJ171 as applicable. See Section 07 92 00 for sealant. Provide at the following locations:
   1. Horizontal Surfaces
      a. Directly over expansion joints.
      b. Over anti-fracture membrane which is applied over structural slab cold joints, construction joints and control joints.
      c. Where tile work abuts restraining surfaces such as perimeter walls, curbs, columns, pipes, etc.
      d. Floor areas exceeding 12 feet in any direction for exterior work and 24 feet in any direction for interior work.
      e. Other locations where indicated.
   2. Vertical Surfaces
      a. Directly over joints in wall substrate including cold joints, construction joints, control joints and expansion joints.
      b. At changes in substrate material.
      c. Where tile work abuts restraining surfaces such as perimeter walls, curbs, columns, pipes, etc.
      d. Where indicated.

E. Curing: Cure tile floor, base, and wall installations in accordance with manufacturer’s recommendations, TCA recommendations, and in accordance with ANSI requirements.

F. Metal Edge Strips: Provide metal edge strips at openings without thresholds, and where exposed edges of tile floors meet other materials.
   1. Except as otherwise indicated, where trim is located across door openings, locate trim on the door side in line with the edge of the door stop, terminating at the rabbet.

G. Marble Thresholds: Provide at openings where exposed edges of tile floors meet other materials.
3.07 REPAIR, CLEAN AND PROTECT

A. Repair, or remove and replace chipped, damaged or otherwise defective work to the satisfaction of the Architect.

B. Cleaning: Upon completion of placement and grouting, clean all tile surfaces so that they are free of foreign matter.
   1. Use methods and materials as recommended by tile manufacturer.
   2. Replace tiles that cannot be satisfactorily cleaned.

C. Grout Sealer: Apply silicone grout sealer to grout joints according to grout sealer manufacturer’s written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer from joints and from tile faces by wiping with soft cloth.

D. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent damage and wear.

   1. Prohibit foot and wheel traffic from using tiled floors for at least 3 days after grouting is completed.
   2. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION
PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide acoustical lay-in panel ceiling system as shown and specified.

1.02 RELATED SECTIONS

A. Gypsum Board Ceiling: Section 09 21 16.

B. Sustainable Design Requirements: Section 01 81 13.

1.03 QUALITY ASSURANCE

A. Workmanship: Comply with Ceilings & Interior Systems Contractors Association (CISCA) “Ceiling Systems Handbook”.

B. Installation: Performed by an experienced authorized installer approved by acoustical material manufacturer.

C. Fire Hazard Classification: Provide acoustical materials which have been UL tested, listed and labeled Class 0-25, when tested in accordance with ASTM E84, Class A flame spread rating in accordance with ASTM E1264 requirements.

D. Reference Standards: Wherever the following abbreviations are used herein, they shall refer to the corresponding standards.

E. Coordination Between Trades: Quality assurance includes the cooperation with HVAC, Plumbing and Electrical Contractors in regards to ceiling grid layout.
   1. Procedures for submitting coordination drawings for ceiling work is included in Section 01 33 23 - Shop Drawings, Product Data and Samples.

1.04 SUBMITTALS

A. Product Data

1. Submit manufacturer's product data and installation instructions for each type of acoustical material and suspension system required.
2. Submit manufacturer's written instructions for recommended maintenance practices for each type of acoustical ceiling system required. Include recommendations for cleaning and refinishing acoustical units and precautions against materials and methods that may be detrimental to finishes and acoustical performances.
B. Samples: Submit 12" square acoustical panel samples for each type of acoustical unit required. Provide 12" long suspension system and edge molding samples.

C. Certification: Submit manufacturer's certification of acoustical units fire hazard classification rating and performance requirements.

D. Special Environmental Requirements: Submit the following in accordance with Section 01 81 13:

1. Recycled Content:
   a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
   b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
   c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
   d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

2. Local/Regional Materials:
   a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
   b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
   c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
   d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unopened protective packaging, with manufacturer's labels indicating brand name, pattern size, thickness and fire rating as applicable, legible and intact.

B. Store materials in original protective packaging to prevent soiling, physical damage or wetting.

C. Store cartons open at each end to stabilize moisture content and temperature.

D. Do not begin installation until sufficient materials to complete a room are received.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
B. Pressurized Plenums (to comply with CISCA's recommendations for cleaning duct system and protecting ceiling units in pressurized plenums from damage and soiling caused by blowing dirt and dust that may be present when duct system is first operated): Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.07 EXTRA MATERIALS

A. Maintenance Stock: Under this Section furnish to the Owner prior to final acceptance, extra maintenance stock of acoustical materials, consisting of a minimum of one percent of area of each size, type, thickness installed on the job, and 4% if the area is under 5,000 sq. ft. This extra stock is for the Owner's use after completion of the Project and is not to be used for repair or replacement required during the construction period. Properly package, seal, and identify extra stock material.

PART 2 PRODUCTS

2.01 SUSPENSION SYSTEM

A. Exposed "Tee" Grid System

1. Description: Cold-rolled electrogalvanized steel, factory applied white finish paint to match ceiling tile.
   a. 15/16" exposed face; DONN (USG INTERIORS) Model DX; ROCKFON Chicago Metallic 200 Snap Grid System; ARMSTRONG Prelude.
   b. 9/16" exposed face; ARMSTRONG Suprafine; DONN (USG INTERIORS) Fineline; ROCKFON Chicago Metallic Tempra 4000.

2. Description: Comply with ASTM C635. Provide systems adequate to support light fixtures, ceiling diffusers, and other normal accessories. Maximum deflection 1/360 of the span. All components of system from one manufacturer, die cut, and interlocking.
   b. Type of System: Direct Hung.
   c. Attachment Devices: Size for five times design load indicated in ASTM C635, Table 1 direct hung.
   d. Hanger Wires: ASTM A641 galvanized carbon steel, soft temper, prestretched not less than 12 gauge.
   e. Carrying Channels: 1-1/2" steel channels, hot-rolled or cold-rolled, not less than 0.475 lbs per linear foot, standard finish.
   f. Members: Provide manufacturer's standard exposed runners, cross runners and accessories of type and profiles indicated, with exposed cross runners coped to lay flush with main runners.
   g. Hold Down Clips: Manufacturer's standard[; provide in areas not scheduled to receive retention clips].
   [h. Retention Clips at Impact Resistant Ceiling: Manufacturer's standard retention clips designed and spaced to secure acoustical tiles in-place against vandalism in public areas (i.e. corridors, classrooms and similar type rooms, student toilet rooms, locker rooms, vestibules, etc.)]
3. Edge Moldings: Hemmed edge wall angles, cold-rolled electrogalvanized steel, factory applied finish to match grid system.

[4. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor's option.]

B. PVC Exposed "Tee" Grid System
1. Material: Extruded, Grade 1, Type 2 virgin PVC, UL 94 V-O, USDA and Agriculture Canada Accepted.
2. Fire Classification: Class A (1) Flame Spread of 5 per UL No 723, Smoke Development of 65.
6. Edge Moldings: Match tee material and color.
7. Manufacturer: KEEL MANUFACTURING, INC., ACOUSTIC CEILING PRODUCTS or equal.

C. Perimeter Trim: Provide extruded aluminum trim at ceiling areas indicated. [Depth as indicated.] Provide curved shapes as indicated. Finish to match ceiling grid as selected by Architect. ARMSTRONG Axiom #AX12STR (Nominal 12” deep x ¾” wide); DONN (USG INTERIORS) Compasso; ROCKFON Infinity.

2.02 ACOUSTICAL UNITS

[A. General
1. Cellulose Base
   a. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor's option.
   b. Toxicity/IEQ: Panel based anti-microbial treatment to inhibit growth of mold and mildew:
      1) Coating-Based Antimicrobial Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment; and showing no mold or mildew growth when tested in accordance with ASTM D3273.
      2) Panel-Based Antimicrobial Treatment: Provide acoustical panels manufactured with antimicrobial treatment in the panels.
   c. Toxicity/IEQ: Vinyl overlays and coatings not permitted.

2. Mineral Base
   a. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor's option.
   b. Toxicity/IEQ: Panel based anti-microbial treatment to inhibit growth of mold and mildew:
      1) Coating-Based Antimicrobial Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment; and showing no mold or mildew growth when tested in accordance with ASTM D3273.
antimicrobial treatment; and showing no mold or mildew growth when tested in accordance with ASTM D3273.

2) Panel-Based Antimicrobial Treatment: Provide acoustical panels manufactured with antimicrobial treatment in the panels.

c. Toxicity/IEQ: Mold and mildew resistant
d. Toxicity/IEQ: Vinyl overlays and coatings not permitted.
e. Toxicity/IEQ: Products shall contain no added formaldehyde.

B. Acceptable Manufacturers: The following models listed are by ARMSTRONG. Equal products by CERTAINTEED or U.S. GYPSUM are acceptable.

C. Type ACT-1: Ultima #1912, 24” x 24” x 3/4”, beveled tegular edge, NRC .70, CAC 35, light reflectance LR-.90, with white, washable finish; 9/16” grid.

D. Type ACT-2: Optima Open Plan #3251, 24” x 24” x 1”, square tegular edge, NRC .95, AC 190, light reflectance LR-.90, with white, washable finish; 9/16” grid.

E. Type ACT-3: Health Zone Ultima #1936, 24” x 24” x 3/4“, beveled tegular edge, NRC .70, CAC 35, light reflectance LR-.86, with white, washable finish; 9/16” grid.

F. Type ACT-4: Fine Fissured #1729, 24” x 48” x 5/8”, square edge, NRC .55, CAC 35, light reflectance LR-.85, with white, washable finish; 15/16” grid.

G. Type ACT-5: Capz #3531, 24” x 96” x 7/8” Optima, reverse tegular edge, NRC .90, light reflectance LR-.90, with white, washable finish; 15/16” grid and cover cap, white finish.

H. Type ACT-6: Optima Open Plan #3256, 48” x 48” x 1”, square tegular edge, NRC .95, AC 190, light reflectance LR-.90, with white, washable finish; 9/16” grid.

I. Type ACT-7: TechZone Optima #3262, 24” x 24” x 3/4”, square tegular edge, NRC .90, AC 190, light reflectance LR-.86, with white, washable finish; 9/16” interlude grid.

J. Type ACT-8: Metal Works, 24” x 96”, perforated; square tegular edge; concealed suspension system. Perforation pattern and color to be selected by Architect.

K. Type ACT-9: WoodWorks Access, 48” x 48”, square edge; upturned perimeter edges; concealed grid. Wood specie as selected by Architect.

L. Type ACT-10: WoodWorks Vector, 24” x 24”, concealed grid; perforated. Perforation pattern and color to be selected by Architect.

2.03 MISCELLANEOUS ITEMS

A. Eggcrate Grilles: [Aluminum panels with white baked finish; 1/2” x 1/2” x 1/2” cell size; .025” thickness.] [White plastic; 1/2” x 1/2” x 1/2” cell size]. DYNAMIC LIGHTING PRODUCTS 516/293-2221, ECOLITE 509/922-8888, SCIENTIFIC LIGHTING PRODUCTS 800/248-0224 or equal.

PART 3 EXECUTION
3.01 INSPECTION

A. Examine substrates, structure and installation conditions. Do not proceed with acoustical ceiling systems work until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling.
   1. Avoid use of less than half widths units at borders.

B. Coordinate with ceiling layout on drawings.

C. Notify Architect of discrepancies between ceiling layout on drawings and ceiling layout proposed. Do not proceed until approved by Architect.

3.03 INSTALLATION

A. Suspension System: Comply with ASTM C636 requirements and be water or laser leveled, maximum deflection of 1/360 of span and maximum surface leveling tolerance 1/8" in 12'-0".

B. Rough Suspension
   1. Hangers: Ceiling suspension systems shall not be supported from ductwork, electrical conduit, heating or plumbing lines or any other utility lines. Each utility and the ceiling suspension system shall be a separate installation and each shall be independently supported from the building structure. Where interferences occur, employ trapeze hangers or supports to avoid interferences with appurtenances requiring servicing. Support all four corners of suspension systems at fluorescent light fixtures.
   2. Wall Molding
      a. Provide edge trim molding at perimeter of acoustical ceiling installation and intermediate vertical surfaces. Use maximum lengths. Miter trim corners to provide tight, accurate joint. Connect moldings securely to substrate surfaces.
      b. Connect moldings to substrate at intervals not over 16" on center and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12'-0".

[3. Hold-Down Clips: Provide at rated ceiling assemblies.]
[4. Retention Clips: Provide on all tiles in areas listed herein.]

C. Acoustical Units
   1. Install acoustical lay-in panels level, in uniform plane, with joints accurately cut to ensure a snug and square fit. All panel faces and edges to be free from damage or soiling.
      a. Fit border units accurately at borders and penetrations.
b. Recreate tegular and decorative edges at wall cuts and other cuts.

c. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and perimeter moldings.

d. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

e. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.

2. Coordinate suspension systems grid layout with electrical lighting fixture lay-out and installation.

3.04 CLEANING

A. After installation, clean soiled or discolored surfaces of acoustical units and exposed suspension members. Comply with manufacturer's recommendations for cleaning and touch-up of minor finish damage.

B. Adjust all sags and twists which develop in ceiling systems. Remove and replace units which are improperly installed and damaged units which cannot be successfully cleaned and repaired to eliminate evidence of damage.

END OF SECTION
PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide resilient flooring as shown and specified. Work includes:
   1. Vinyl composition tile flooring.
   2. Rubber tile flooring.
   3. Sheet vinyl flooring.
   4. Flexible terrazzo tile.
   5. Base.
   7. Linoleum.
   8. Luxury vinyl tile.
   9. Adhesives and accessories to complete the work.

1.02 RELATED SECTIONS

A. Sustainable Design Requirements: Section 01 81 13.

1.03 QUALITY ASSURANCE

A. Provide each type of resilient flooring and base material produced by one manufacturer, including recommended adhesives and leveling compounds.

B. Provide each type resilient flooring and base material from same production run. Colors shall be uniform throughout.

C. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

D. Reference Standards: Wherever the following abbreviations are used herein, they shall refer to the corresponding standard.
   2. FS: Federal Specifications as established by the U.S. Government, General Services Administration.
   4. ADA: Americans with Disabilities Act Accessibility Guidelines.

E. Slip Retardant Performance: Unless a greater performance is specified under a specific product, all floor materials must have a minimum static coefficient of friction of 0.6.

1.04 SUBMITTALS

A. Submit manufacturer's product data and installation instructions for each type of resilient flooring, base and accessory required.
B. Samples

1. Tiles: Submit full sized samples of each type, color and pattern required to illustrate the full range of color variations.

2. Base: Provide 6" lengths of each type and color.

3. Sheet Flooring: Manufacturer's standard sample size, but not less than 6" x 9" of each type, color and pattern required to illustrate the full range of color variations.
   a. Heat Welding Bead: Manufacturer's standard sample size, but not less than 9" long of each color.

4. Stair Treads: 6" lengths of each type and color.

C. [Shop Drawings: Show locations of each type and color of tile and tile pattern.]

D. Submit manufacturer's certification that resilient flooring furnished complies with required fire test performance and has been tested and meets indicated requirements.

E. Submit manufacturer's written instructions for recommended maintenance practices for each type of resilient flooring, base and accessory material required.

F. Extra Stock: Furnish extra materials in the following quantities:
   1. Tiles and Base: Furnish 2% of the total quantity (but not less than 2 full sealed cartons) of each type, pattern and color. Provide 5% of colors with less than 5000 square feet. Properly package and identify each material.
   2. Sheet Goods: Furnish 10 linear feet in roll form for each 500 linear feet or fraction thereof, of each product, color and pattern. Package each roll with protective covering and identification labels describing contents.
   3. Stair Accessories: Furnish 5% of the total quantity of each type, pattern and color. Properly package and identify each material.

G. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

H. Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

I. Special Environmental Requirements: Submit the following in accordance with Section 01 81 13):
   1. Submit product documentation for Sealant and Adhesives, documentation indicating VOC Content

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened labeled containers.

B. Store, protect, and handle resilient flooring materials in accordance with manufacturer's recommendations to prevent damage, soiling and deterioration.

C. Store materials in areas to receive resilient flooring for a minimum of 48 hours before installation.
1.06 PROJECT CONDITIONS

A. Maintain uniform room temperature range not less than 70 degrees F., in areas to receive resilient flooring for minimum 48 hours before installation and 48 hours after installation.

B. Provide adequate lighting and ventilation during installation and clean-up.

C. Protect adjoining surfaces from damage and soiling.

PART 2 PRODUCTS

2.01 RESILIENT FLOORING MATERIALS

The following floor types are materials and specifying methods from previous projects. Each project to have materials selected specific to the project.

A. Vinyl Composition Tile: ASTM F1066, Class 1 or 2 as applicable, 12" x 12" x 1/8", manufactured without asbestos.

[1. Colors, Patterns and Manufacturers
   a. Basis of Design: Colors and types indicated on the drawings are based on Essentials manufactured by MANNINGTON.
   b. Other Acceptable Manufacturers: Products manufactured by ARMSTRONG or TARKETT are acceptable providing they meet the requirements specified herein and are an acceptable color match as approved by the Architect. Color match should be submitted to the Architect during bidding for inclusion by an Addendum.]

[1. Colors, Patterns and Manufacturers
   a. Basis of Design: As indicated on the drawings.
   b. Other Acceptable Manufacturers: Vinyl composition tile manufactured by other manufacturers will be considered if materials meet the requirements of the Basis of Design and the sizes and colors are an acceptable match as approved by the Architect prior to bid opening. These additionally approved manufacturers will be included by Addendum. An unacceptable pattern or color match is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.]

[1. Manufacturer and Type: Imperial Texture Excelon by ARMSTRONG; Essentials manufactured by MANNINGTON; Expressions by TARKETT.
2. Colors: Selected by Architect from manufacturer's full color range.]

B. Rubber Tile: Smooth rubber tile flooring complying with ASTM F1344, Class I, 1/8" thick, 12" x 12", integral marbleized colors.
   1. Manufacturer and Type: No. 1000 T by R.C. MUSSON CO. or equal as approved by Architect as manufactured by BURKE FLOORING PRODUCTS; FLEXCO DIVISION TEXTILE RUBBER CO.; R.C.A. RUBBER CO.

C. Strip Vinyl Flooring
   1. Type: Meets Reference Specification ASTM F1066, Composition 1, Class
2. Flooring shall contain a minimum of 90 percent recycled material.
3. Thickness: 1/8”.

3. Style and Manufacturer
   a. Basis of Design: Colors indicated on the drawings are based on Natural Creations - Mystic manufactured by ARMSTRONG.
   b. Other Acceptable Manufacturers: Products manufactured by CENTIVA or SINCOL are acceptable providing they meet the requirements specified herein and are an acceptable pattern and color match as approved by the Architect. Color match should be submitted to the Architect during bidding for inclusion by an Addendum.

D. Sheet Vinyl
   1. Type: Commercial quality flooring composed of solid vinyl wear layer and a backing of filled fibrous composition.
   2. Manufacturer and Model: Medintech by ARMSTRONG or equal as approved by Architect as manufactured by TARKETT or MANNINGTON.
   3. Solid vinyl wear layer designs/pattern and color shall extend uniformly throughout the wear thickness.
   4. Seams: Chemically bonded.
   5. Smoke Development: 450 or less (ASTM E662).
   6. Critical Radiant Flux: 0.45 watts/cm² or more (ASTM E648).
   7. Size: 6 ft. wide roll stock.

E. Sheet Vinyl
   1. Type: Commercial quality flooring composed of solid vinyl wear layer and a backing of filled fibrous composition.
   2. Style and Manufacturer
      a. Basis of Design: Colors indicated on the drawings are based on Timberline manufactured by ARMSTRONG.
      b. Other Acceptable Manufacturers: Products manufactured by TARKETT or MANNINGTON are acceptable providing they meet the requirements specified herein and are an acceptable pattern and color match as approved by the Architect. Color match should be submitted to the Architect during bidding for inclusion by an Addendum.
   3. Solid vinyl wear layer designs/pattern and color shall extend uniformly throughout the wear thickness.
   4. Seams: Chemically bonded.
   5. Smoke Development: 450 or less (ASTM E662).
   6. Critical Radiant Flux: 0.45 watts/cm² or more (ASTM E648).
   7. Size: 6 ft. wide roll stock.

F. Sheet Vinyl – Slip Resistant
   1. Type: Commercial quality flooring composed of solid vinyl wear layer and a backing of filled fibrous composition.
   2. Style and Manufacturer
      a. Basis of Design: Colors indicated on the drawings are based on
MANNINGTON Assurance.

b. Other Acceptable Manufacturers: Products manufactured by TARKETT or ARMSTRONG are acceptable providing they meet the requirements specified herein and are an acceptable pattern and color match as approved by the Architect. Color match should be submitted to the Architect during bidding for inclusion by an Addendum.

3. Solid vinyl wear layer designs/pattern and color shall extend uniformly throughout the wear thickness.

4. Seams: Chemically bonded.

5. Smoke Development: 450 or less (ASTM E662).

6. Critical Radiant Flux: 0.45 watts/cm² or more (ASTM E648).

7. Size: 6 ft. wide roll stock.

8. Gage: .080”.

9. Slip Retardant Performance
   a. ASTM D2047; conform to the following:
      1) Leather Dry (Wet): 0.72 (0.85)
      2) Neolite Dry (Wet): 0.88 (0.84)
      3) Rubber Dry (Wet): 1.08 (1.14)
   b. Meet ADA static coefficient of friction for accessible routes (Paragraph A4.5).

G. Terrazzo (Flexible) Tile
   1. Description: Tiles comprised of stone chips embedded in flexible thermo-set resin matrix.
   2. Size: 12” x 12” x 1/8”.
   3. Stone Chips: Graded to 1/4” maximum size.
   4. Physical Properties
      a. Abrasive Wear - Mil. Spec. MIL-F-52505, Tabor Abraser, CS-17 wheels, 1000 cycles with 1000 gram load: 0.0005” maximum wear loss.
      c. Hardness - Shore D Hardness: Resin 75-83, maximum
      d. Flame Resistance - ASTM E648: 0.45 wall/cm² minimum.
   5. Manufacturer and Model: Fritztile Granite Tile GS5000 Series by FRITZ CHEMICAL COMPANY. Products by other manufacturers are acceptable providing they meet the requirements specified herein and are approved by the Architect, prior to bid, in accordance with the substitution/manufacturer approval process.

[6. As indicated on Drawings]

[6. Colors and Patterns
   a. Type A: GS5012 Royal White.
   b. Type B: GS5086 Emerald Green.
   c. Type C: GS5020 Staley Black.]

H. Sheet Linoleum
   1. Type: Commercial quality flooring; 0.080” gage; ASTM F2034.
      a. Fire Test Data
         1) Critical Radiant Flux – ASTM E648: Class 1; 0.45 watts/cm²
         2) Smoke Developed – ASTM E662: 450 or less.
2. Manufacturer and Model: Marmorette by ARMSTRONG or equal as approved by Architect as manufactured by TARKETT or MANNINGTON.
   a. Colors: As selected by Architect.

I. Static Dissipative Vinyl Composition Tile: ASTM F1066, Class 2 (through pattern tile), 12" x 12" x 1/8", manufactured without asbestos.
   1. Fire Test Data
      a. Smoke Development: 450 or less (ASTM E662).
      b. Critical Radiant Flux: 0.45 watts/cm² or more (ASTM E648).
   2. Electrical Properties: Installed system to conform to the following properties:
      a. Resistance
         1) Reference: ESD-S7.1 and ASTM F150
         2) Point-to-point and point-to-ground: $10^6$ to $10^9$ ohms.
      b. Static Generation
         1) Reference: ESD STM 97.2 (flooring in combination with footwear and a person)
         2) At 40% Relative Humidity with ESD Shoes: <10 volts
         3) At 12% Relative Humidity with ESD Shoes: <100 volts
      c. Static Decay
         1) Flooring in combination with footwear (ESD Shoes) and a person (5000 volts to zero): 0.5 seconds average
         2) Fed. Test 101C, Method 4046 (5000 volts to zero): <0.5 seconds
   3. Colors, Patterns and Manufacturers
      a. Basis of Design: Colors and types indicated on the drawings are based on SDT Static Dissipative Tile manufactured by ARMSTRONG.

   1. Thickness: 1/8".
   2. Colors, Patterns and Manufacturers
      a. Basis of Design: Premium vinyl tile strips indicated on the drawings are Bamboo pattern manufactured by CENTIVA.
      b. Other Acceptable Manufacturers: Vinyl tile strips manufactured by ARMSTRONG, SINCOL or other manufacturers will be considered if materials meet the requirements of the Basis of Design and the sizes, patterns and colors are an acceptable match as approved by the Architect prior to bid opening. These additionally approved manufacturers will be included by Addendum. An unacceptable pattern or color match is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.

   1. Thickness: 1/8".
   2. Size: 18" x 18".
   3. Physical Properties

4. Colors, Patterns and Manufacturers
   a. Basis of Design: Enhanced vinyl tile indicated on the drawings are Azrock Cortina Grande manufactured by TARKETT.
   b. Other Acceptable Manufacturers: Vinyl tile manufactured by ARMSTRONG, MANNINGTON or other manufacturers will be considered if materials meet the requirements of the Basis of Design and the sizes, patterns and colors are an acceptable match as approved by the Architect prior to bid opening. These additionally approved manufacturers will be included by Addendum. An unacceptable pattern or color match is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.

L. Rubber Sheet Flooring – Drawing Reference RB-1: Smooth rubber flooring; non-laminated, single ply surface made from multiple colored reprocessed EPDM rubber.
   1. Thickness: 4 mm
   2. Format: 4’-0” rolls.
   3. Manufacturer, Colors and Patterns
      a. Basis of Design: Colors indicated on the drawings are based on ECOEarth manufactured by ECO SURFACES.
      b. Other Acceptable Manufacturers: Products manufactured by other manufacturers are acceptable providing they meet the requirements specified herein and are an acceptable pattern and color match as approved by the Architect. Color match should be submitted to the Architect during bidding for inclusion by an Addendum.

M. Luxury Vinyl Strip and Tile Flooring
   1. Type: Meets Reference Specification ASTM F1700, Type B, Class III
   2. Thickness: 2.5 mm total with 28 mil urethane wearlayer.
   3. Sizes: As indicated.
   4. Properties:
      a. Static Load: ASTM F970 Meets Requirements
      b. Indentation – Residual (75 Lbs): Meets Requirements
      c. Coefficient Of Friction: ASTM D2047 0.65 (Dry)
      d. Fire Rating: ASTM E648 Class I
      e. Smoke Density ASTM E662: Meets Requirements
   5. Colors, Patterns and Manufacturers
      a. Basis of Design: As indicated on the drawings.
      b. Other Acceptable Manufacturers: Vinyl flooring manufactured by other manufacturers will be considered if materials meet the requirements of the Basis of Design and the sizes and colors are an acceptable match as approved by the Architect prior to bid opening. These additionally approved manufacturers will be included by Addendum. An unacceptable pattern or color match is reason for disapproval of product and manufacturer.
A. Vinyl Base: Complying with ASTM F1861, Type TV, Group 1, 4" high, 1/8" gage. Provide long length rolls and job formed corners. Standard top set cove (Style B) at resilient and other hard surface flooring and straight toeless (Style A) at all carpeted floors.

A. Rubber Base: Complying with ASTM F1861, Type TP, Group 1, 4" high, 1/8" gage. Provide long length rolls and job formed corners. Standard top set cove (Style B) at resilient and other hard surface flooring and straight toeless (Style A) at all carpeted floors.

[1. Colors and Manufacturers
a. Basis of Design: Colors and types indicated on the drawings are manufactured by JOHNSONITE/TARKETT.
b. Other Acceptable Manufacturers: Products manufactured by VINYL PLASTIC, INC. (VPI) or ROPPE are acceptable providing they meet the requirements specified herein and are an acceptable color match as approved by the Architect. Color match should be submitted to the Architect during bidding for inclusion by an Addendum.]

[1. Colors and Manufacturers
a. Basis of Design: As indicated on the drawings.
b. Other Acceptable Manufacturers: Vinyl base manufactured by other manufacturers will be considered if materials meet the requirements of the Basis of Design and the colors are an acceptable match as approved by the Architect prior to bid opening. These additionally approved manufacturers will be included by Addendum. An unacceptable color match is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.]

[1. Manufacturers: VINYL PLASTIC, INC.; JOHNSONITE/TARKETT; ROPPE.

2. Colors: Selected by Architect from manufacturer's full color range.]
A. Stair Treads and Risers: Homogeneous, rubber treads with textured finish complying with ASTM F2169.

1. Manufacturer and Model: BMTR by JOHNSONITE/TARKETT.
   a. Other Acceptable Manufacturers: Products manufactured by VINYL PLASTIC, INC. (VPI) or ROPPE or other manufacturers are acceptable providing they meet the requirements specified herein and are an acceptable color and style match as approved by the Architect. Style match should be submitted to the Architect during bidding for inclusion by an Addendum.

2. Colors: Charcoal gray.

B. Rubber Floor Tiles: ASTM F1344: Standard Specification for Rubber Floor Tile (sections 7.1-7.6, 8.4-8.6). Manufactured in a single homogeneous layer.

1. Thicknesses: 0.118”
2. Finish: slate.
4. Performance: Product tested in accordance with ASTM F1344 (tile flooring). Conform to the following:
   b. Critical Radiant Flux - ASTM E648, NFPA 101: 0.78 W/cm², Type I
   c. Optical Density of Smoke - ASTM E662: < 450, Class I
   d. Static Load Limit - ASTM F970: 1000psi (residual indentation 0.001 in. at 50 psi)
   f. Coefficient of Friction - ASTM D 2047: 0.66 dry, 0.69 wet

5. Manufacturer
   a. basis of Design: Type and color indicated on the drawings are based on MONDO.
   b. Other Acceptable Manufacturers: Products manufactured by other manufacturers are acceptable providing they meet the requirements specified herein and are an acceptable color and style match as approved by the Architect. Tile match should be submitted to the Architect during bidding for inclusion by an Addendum.

C. Stair Nosings

1. Material: Homogeneous composition of polyvinyl chloride (PVC), high quality additives, and colorants to meet the performance requirements of ASTM F2169 Standard Specification for Resilient Stair Treads, Type TV, Class 1 and 2, Group 1 and 2.
2. Description: Visually Impaired Double Undercut Carpet Vinyl Stair Nosing, 2” hinged square nose configuration 3-3/16” tread depth with 2” co-extruded photo luminescent strip, undercut for 1/4” to 5/16” carpet on step and riser
3. Model and Manufacturer: JOHNSONITE/TARKETT Model VIVCD-XX.
   a. Other Acceptable Manufacturers: Products manufactured by VINYL PLASTIC, INC. (VPI) or ROPPE or other manufacturers are acceptable providing they meet the requirements specified herein and are an acceptable color and style match as approved by the Architect.
2.04 ACCESSORIES

B. Leveling Compound: Non-staining latex modified, Portland cement based type, compatible with flooring, as provided or recommended by the flooring manufacturer.

C. Adhesives: Waterproof, stabilized type as recommended by the resilient flooring and base manufacturer to suit material and substrate conditions.
   1. VOC Content: The volatile organic compound (VOC) content of adhesives shall not exceed the limits defined in Rule #1168 “Adhesive and Sealant Applications” of the South Coast Air Quality Management District (SCAQMD), of the State of California. All VOC limits are defined in grams per liter, less water and less exempt compounds (determined by U.S. EPA Reference Test Method 24). The VOC limits are as follows:
      a. Water-based contact cement: 250 g/L
      b. Water-based construction adhesive: 100 g/L

D. Resilient Edge/Transition Strips: Provide rubber or stainless steel transition strips by the following manufacturers.
      a. ROPPE, #56
      b. JOHNSONITE/TARKETT, CTA-XX-H
      c. VPI FLOORING, ACC12
   2. Resilient-to-Concrete: Stainless steel
      a. SCHLUTER Reno U; stainless steel
      b. GREAT LAKES TILE PRODUCTS; Reducer.
      c. BLANKE CORP.; Reducer Trim.
   3. Where transition types are required for conditions other than those listed above, provide rubber type from the manufacturers listed to create a smooth transition or termination.

E. Cleaning and Polishing Materials: Polish and neutral cleaner as recommended by the floor material manufacturer.

F. Existing Adhesive Remover: Non-toxic type; similar to De-Sol-It by ORANGE-SOL or equal by NAPIER ENVIRONMENTAL TECHNOLOGIES, INC., or CITRUS KING.

G. Terrazzo Tile Sealer and Finisher: FRITZ CHEMICAL COMPANY FCP-102 Secondary Coat Sealer and FCP-200 Buff-On or similar type products as recommended by tile manufacturer and approved by Architect.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine substrates and installation condition. Do not proceed with resilient
flooring work until unsatisfactory conditions have been corrected.

B. Subfloor surfaces shall be smooth, level, at the required finish elevation, and within the tolerances specified in Section 03 30 00.

C. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 PREPARATION

A. Prepare substrates according to floor manufacturer’s written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
   3. Perform tests recommended by flooring manufacturer. Proceed with installation only after satisfying manufacturer’s recommendations for test results.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install flooring until it is the same temperature as the space where it is to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.03 INSTALLATION

A. Install resilient flooring and accessories with adhesive in strict compliance with the manufacturer’s recommendations. Butt tightly to vertical surfaces, thresholds, nosings and edgings. Scribe around obstructions and to produce neat joints, laid tight, even and straight. Extend flooring into toe spaces, door reveals and into closets and similar openings.

B. Tile Flooring
   1. Lay tile flooring with joints tight, in true alignment and parallel to walls of rooms and corridors.
   2. Lay tile symmetrically about centerlines of space, without pattern or borders. Adjust layout to avoid use of cut widths less than one-half tile at room perimeter.
   3. Match tile for color by using manufactured and packaged sequence.
   4. Broken, cracked, or deformed tiles are not acceptable.
   5. Immediately after installation, thoroughly roll tile with a 150 lb. sectional
roller until a firm, uniform bond has been obtained.

C. Static Dissipative Tile Flooring: In addition to the above requirements, conform to ARMSTRONG Installation System Manual F-5061 or similar type recommended system by other approved manufacturer.

D. Base
1. Install at walls, column, casework and other permanent fixtures as scheduled. Install in as long of lengths as practicable. Tightly bond base to backing throughout length of each piece, with continuous contact at horizontal and vertical surfaces.
2. Provide terminal base ends beveled and toes rounded.
3. On masonry surfaces or other similar irregular surface, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

E. Sheet Flooring
1. Install sheet flooring in accordance with latest edition of manufacturers' instructions.
2. Spread only enough adhesive to permit installation of sheet flooring before initial set.
3. Install flooring wall to wall before installation of floor-set cabinets, casework and similar moveable items.
4. Extend flooring into door recesses, closets, and similar openings as indicated on drawings.
5. Where adjacent floor finish is dissimilar, terminate sheet flooring at centerline of doors.
6. Scribe, cut, and fit to walls, columns, cabinets, pipes, built-in-furniture and cabinets to produce tight joints. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips.
7. Sheet flooring shall be installed over covers for telephone conduits, electrical conduits and other similar items which occur within the finished floor areas.
8. Sheet flooring MUST be cut sharp and clean around these covers so that the covers can be removed when required.
9. Sheet flooring must be applied to covers in a solid application of adhesive.

F. Edge Strips: Place tightly butted to flooring and secure with adhesive. Install at edges of flooring which would otherwise be exposed.

G. Stair Treads and Accessories
1. Tightly fit tread nose against face of stair riser or nosing. Fill open spaces at the nosing between the stair and the rubber tread with manufacturer's approved caulk or similar material.
2. Roll surfaces until a firm bond is obtained.

3.04 CLEANING AND PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

B. After flooring has set, clean thoroughly. Remove excess adhesive or other surface
blemishes from flooring, using neutral type cleaners as recommended by the flooring manufacturer.

C. Perform initial maintenance according to latest edition of manufacturer's maintenance manual and the following:

1. Vinyl composition Tile: Clean, apply polish, and buff with type of polish, number of coats and buffing procedures in accordance with manufacturer's instructions.

2. Terrazzo Tiles: Seal all terrazzo tile areas with two coats of sealer. Apply sealer after adhesive has set (no sooner than 48 hours after installation, but prior to any use of the floor area). Buff terrazzo tile areas as recommended by tile manufacturer.

D. Protect installed flooring from damage and staining with heavy duty non-staining Kraft paper or other covering at all traffic lanes. Protect completed work from traffic and damage until final acceptance.

END OF SECTION
SECTION 09 67 23

RESINOUS FLOORING

PART 1  GENERAL

1.01  WORK INCLUDED

A. Work includes seamless floor toppings [and integral cove base]. Work includes slab preparation.

[B. Where no curb is shown on drawings, provide steel angles in accordance with manufacturer’s recommendations around all floor penetrations, floor openings and open floor edges/door openings, to receive integral base application.]

1.02  RELATED SECTIONS

A. Sustainable Design Requirements: Section 01 81 13.

B. Concrete finishes: Section 03 30 00.

C. Concrete slab preparation: Section 01 73 00.

1.03  QUALITY ASSURANCE

A. Reference Specifications: Wherever the following abbreviations are used herein, they shall refer to the corresponding standard.

2. MIL: Military Standards
3. ACI: American Concrete Institute
4. ADA: Americans with Disabilities Act Accessibility Guidelines.

B. Installer Qualifications

1. Approved by flooring manufacturer. Provide supervisory personnel trained by flooring manufacturer in the proper application of product.

2. Minimum 5 years experience in resinous type flooring with previous experience in comparable size projects.

C. Slip Retardant Performance: Unless a greater performance is specified under a specific product, all floor materials must have a minimum static coefficient of friction of 0.6.

1.04  SUBMITTALS

A. Product Data: Submit for all items.

B. Samples

1. Color Selection: Submit manufacturer's color charts showing full range of colors available.

2. Job Standards: Submit 12" x 12" inch square samples of cured resilient flooring applied to rigid backing, in texture, finish and colors required.
1.05 JOB CONDITIONS

A. Proper Surfaces
1. Even, sound, thoroughly clean and dry and free of all defects that might adversely affect the flooring work.
2. All floors to receive resinous flooring shall be wet cured only. No curing compound shall be used.

B. Related Work: Work which passes through, beneath or behind flooring must be completed prior to starting any flooring work.

C. Temperature Requirements
1. Temporary Heat: Provide as required to maintain the minimum temperature during flooring installation and for at least one week after installation.
2. Minimum Temperature: 50 degrees F.; do not install over surfaces which have frost on them.
3. Humidity: Do not apply coatings when relative humidity exceeds 85% or to damp or wet surfaces; unless otherwise permitted by manufacturer's printed instructions.

D. Ventilation: Provide adequate ventilation to prevent accumulation of hazardous fumes during application of solvent-based products in enclosed spaces, and maintain until coatings have cured.

PART 2 PRODUCTS

2.01 SEAMLESS RESINOUS FLOORING - TYPE 1

A. Manufacturer CROSSFIELD PRODUCTS CORPORATION Dex-O-Tex Décor-Flor; BASF Selbatwede 41; STONHARD Stonshield SLT; KEY RESIN B-125. Equal products by POLYAMERICA, GENERAL POLYMERS CORPORATION, CARBOLINE (Sanitile) or STRATASHIELD (TNEMEC) Ultra-Tread, are acceptable providing they meet the requirements specified herein.

B. Materials
1. Type: Troweled two-component resinous flooring consisting of colored quartz granules embedded in clear mastic.
2. Thickness: 1/8" minimum.
3. Colors: Colors of quartz aggregate as selected by Architect from manufacturer's standard colors.

C. Performance and Properties
3. Adhesion: ASTM D4541 or ACI 503 – Minimum 300 psi; concrete failure.
5. Abrasion Resistance: One of the following:
b. ASTM D4060 (CS-17 Wheel, 1000 cycles): Maximum .060g loss.

6. Tensile Strength: One of the following:
   a. ASTM D638: 4,400 psi resin.
   b. ASTM C307: Minimum 1,600 psi.

7. Slip Retardant Performance
   a. All floor surfaces must have a minimum static coefficient of friction of 0.6.
   b. Meet ADA static coefficient of friction for accessible routes (Paragraph A4.5).

D. Colors: As selected by Architect.

2.02 SEAMLESS RESINOUS FLOORING - TYPE 2

A. Location: Use in mechanical equipment areas and rooms on the interior of curbed areas. Install on both floor surface and vertical curb surfaces to provide a watertight overflow area.

B. Type and Manufacturer: Trowel applied fabric reinforced waterproof membrane. Dex-O-Tex M-E Flooring System by CROSSFIELD PRODUCTS CORPORATION. Products manufactured by BASF; STONHARD; KEY RESIN; POLYAMERICA, GENERAL POLYMERS CORPORATION, CARBOLINE (Sanitile) or TNEMEC, are acceptable providing they meet the requirements specified herein.

C. Thickness: 3/16 inch, unless otherwise recommended by manufacturer.

D. Performance Properties
   1. Waterproofness: Smith Emery Laboratories test procedure (samples 18 inch diameter subjected to 50 pounds per inch water pressure for 60 minutes. Test for amount of water forced through in grams): None.
   2. Tensile Strength and Elongation: ASTM D1117.
      a. Elongation Dry: 29%.
      b. Breakdown Dry: 79 pounds per inch.
      c. Elongation Wet: 31%.
      d. Breakload Wet: 67 pounds per inch.
   3. Indentation Characteristics (steadily applied load): MIL-D-3134, Para. 4.7.2.1 (2,000 pounds on 1 inch steel ram imposed for 30 minutes): Less than 5%.
   4. Indentation Characteristics (impacted load): MIL-D-3134, Para. 4.7.3 (2 pound steel ball dropped from 8 foot height): No cracking or loosening.
   5. Resistance to Elevated Temperatures: MIL-D-3134, Para. 4.7.5.1: No flow or slip.
   6. Slip Retardant Performance
      a. All floor surfaces must have a minimum static coefficient of friction of 0.6.
      b. Meet ADA static coefficient of friction for accessible routes (Paragraph A4.5).

E. Color: As selected by Architect.
PART 3 EXECUTION

3.01 PREPARATION

A. Prepare substrates according to floor manufacturer's written instructions to ensure adhesion of flooring products.

B. Concrete Substrates
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by flooring manufacturer. Do not use solvents.
   3. Perform tests recommended by flooring manufacturer. Proceed with installation only after satisfying manufacturer's recommendations for test results.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PROTECTION OF ADJOINING WORK

A. Protect adjacent and adjoining work, not scheduled to receive flooring, and maintain free from flooring materials.

3.03 INSTALLATION

A. Install and cure in accordance with the Construction Documents and manufacturer's instructions and recommendations.

B. Apply to thicknesses specified herein.

C. Finish surfaces flush, true to plane and line with no visible trowel or squeegee marks and level within tolerance of 1/8 inch in 10 feet in any direction.

D. Waterproofing Membrane: Apply floor system manufacturer's recommended waterproof membrane prior to application of resinous flooring. Limits of waterproof membrane are as indicated on the drawings.

3.04 CLEANING AND PROTECTION

A. Protect flooring materials from damage and wear during construction operations. Where temporary cover is required for this purpose, comply with manufacturer's recommendations for protective materials and the method of their application.
Remove temporary covering just prior to cleaning for final inspection.

B. Clean flooring just prior to final inspections. Use materials and procedures recommended by flooring manufacturer.

END OF SECTION
SECTION 09 68 00

CARPETING

PART 1  GENERAL

1.01  WORK INCLUDED

A. Carpet, installation and all glue, edge guards, [pad] and accessories necessary for the installation.

B. Work includes preparation of subsurfaces, cleaning, and protection of finished carpet.

1.02  RELATED SECTIONS

A. Sustainable Design Requirements: Section 01 81 13.

1.03  QUALITY ASSURANCE

A. Installer: Firm with not less than 5 years of carpeting experience similar to work of this Section.
1.  Work not in compliance with the manufacturer's recommended standards and procedures shall be promptly corrected at the Contractor's expense.

B. Manufacturer: Firm (carpet mill) with not less than 5 years of production experience with similar types specified in this section; and whose published product data clearly indicates compliance of product with requirements of this Section.

C. General Standard: "Carpet Specifiers Handbook" by The Carpet and Rug Institute; for definitions of terminology not otherwise defined herein, and for general recommendations and information.

D. Fire Performance Characteristics: Provide carpet that is identical to that tested for the following fire performance requirements, according to test method indicated, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
2.  Critical Radiant Flux - ASTM E684: Not less than 0.45 watts per square centimeter.
3.  Smoke Density - ASTM E84: 450 or less.

1.04  REFERENCE STANDARDS

A. Carpet: Comply with the [local building authority] IBC for flame spread and smoke contribution requirements and tested in accordance with ASTM E84.

1.05  SUBMITTALS
A. Samples
1. **Broadloom:** Submit 12” x 12” samples of each color and pattern selected.
2. **Tiles:** Submit full size tiles (samples) of each color and pattern selected.
3. **Accessories:** 12” long sample of each type exposed edge stripping and accessory item.

B. **Product Data:** Provide for all items. Include, product data covering carpet construction, physical characteristics, durability, resistance to fading, and flame resistance characteristics.

C. **Shop Drawings**
1. **Broadloom:** Submit seam diagram drawings and edge treatments.
2. **Tiles:** Submit drawings showing layout. Indicate pile or pattern direction and locations and types of edge strips.

D. **Certifications:** Contractor shall provide the following:
1. **Manufacturer:** Before carpet materials are ordered, submit 4 copies of test results from a recognized laboratory and 4 copies of a notarized statement, signed by an officer of the manufacturer, confirming that the carpet products proposed for use are those which have passed the required tests indicated under "Performance Standards" for the carpet and comply with the requirements of State and local fire authorities.
2. **Installer:** Submit 4 copies attesting that materials actually installed were the same as those certified as meeting specified requirements.

E. **Special Environmental Requirements:** Submit the following in accordance with Section 01 81 13:
1. **Recycled Content**
   a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product. Indicate percentage of recycled content per unit weight of product.
   b. Salvaged/Refurbished: Indicate percentage of salvaged and/or refurbished content per unit of product.
2. **Local/Regional Materials**
   a. Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
   b. Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
3. **VOC Data**
   a. **Adhesives**
      1) Submit manufacturer’s product data for adhesives. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
      2) Submit Green Seal Certification to GS-36 and description of the basis for certification.
      3) Submit manufacturer’s certification that products comply with SCAQMD #1168.
   b. **Carpet:** Submit manufacturer’s certification of compliance with Carpet and Rug Institute’s Green Label Plus Testing Program.
   c. **Carpet Cushion** (where applicable): Submit manufacturer’s
F. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

G. Documentation of manufacturer’s take-back program for carpet. Include the following:
   1. Appropriate contact information.
   2. Overview of procedures.
      a. Indicate manufacturer’s commitment to reclaim materials for recycling and/or reuse.
   3. Limitations and conditions, if any, applicable to the project.

1.06 PRODUCT DELIVERY AND STORAGE

A. Deliver carpeting materials in original mill protective wrapping, and store inside protected from weather, moisture and soiling.

B. Investigate and resolve access restrictions, including elevator capacity, entrances and accessibility, to assure proper delivery and installation of materials.

C. Protect materials against damage of any kind. Damaged products, including soiled fabrics, will be rejected.

1.07 MAINTENANCE

A. Manufacturers: Provide three (3) copies of maintenance schedules, describing programmed maintenance procedures, including general maintenance, preventative maintenance, spot removal, traffic lane maintenance and overall cleaning.

B. Operational Service: Provide manufacturer’s take-back program service for carpet installed in project. Service shall reclaim materials for recycling and/or reuse. Service shall not landfill or burn reclaimed materials.

1.08 WARRANTY

A. Special Project Warranty: Submit a written warranty, executed by the Contractor, Installer and the Manufacturer, agreeing to repair or replace carpeting which fails in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
   1. Warranty period is two years after date of substantial completion.

B. Carpet manufacturer’s material wear warranty: Ten years.

1.09 EXTRA MATERIALS

A. Broadloom: Provide quantity of full-width carpet equal to 5 percent of amount installed. In addition, turn over to Owner all usable scraps of carpet. Usable
scraps are defined to include roll ends of less than 9 ft. length, and pieces of more than 3 sq. ft. area and more than 8 inches wide.

B. Tiles: Provide quantity of full tiles for each type of material equal to 5 percent of amount installed.

C. Deliver extra carpet materials to Owner’s designated storage space, properly packaged with protective covering and identified with labels describing contents.

**PART 2 PRODUCTS**

2.01 CARPET

A. Environmental Requirements

1. Carpet Systems
   a. Toxicity/IEQ: Carpet systems must meet or exceed the requirements of the Carpet and Rug Institute Green Label Plus Testing Program.
   b. Salvaged/refurbished: Carpet system fabricated from minimum 90 percent salvaged carpet or carpet tile.

2. Nylon Carpet Face Fiber
   a. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor’s option.

3. Natural Carpet Face Fiber:
   a. Toxicity/IEQ: Chemical treatments, including moth treatment, are not permitted.
   b. Biobased content: Provide fiber manufactured from minimum 85 percent biobased materials.
      1) Wool

4. Carpet Backing
   a. Toxicity/IEQ: Carpet Backing/Cushion systems must meet or exceed the requirements of the Carpet and Rug Institute’s Green Label Testing Program.
      1) Biobased Content: Minimum 85 percent natural latex, jute, or cotton.
   b. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor’s option.

Select and edit B thru E in detail

B. Manufacturers, Styles and Colors

1. Basis of Design: Manufacturers, styles and colors as indicated on the drawings.

2. Other Acceptable Manufacturers: Carpet manufactured by other manufacturers will be considered if materials meet the requirements of the Basis of Design and the color and style are acceptable matches as approved by the Architect prior to bid opening. These additionally approved manufacturers and carpets will be included by Addendum. An unacceptable color match or style is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.]
B. Manufacturers, Styles and Colors
1. CR-1
   J&J INVISION, “Payday”, Color: 1405 Trust Fund
   ATLAS, “Arnhem”, Color: Barberry Rose
   BENTLEY PRINCE STREET, “Illuminaire”, Color: Red Carpet
2. CR-2
   BOLYU, “Illusions”, Color: IU884 Sting
   ATLAS, “Onslow”, Color: Barley Rose
   BENTLEY PRINCE STREET, “Illuminaire”, Color: Red Carpet

B. Manufacturers
1. Basis of Design: Carpets selected are based on carpet tiles by MILLIKEN,
   ATLAS and INTERFACE.
2. Other Acceptable Manufacturers: Carpet manufactured by manufacturers
   other than the basis of design will be considered if materials meet the
   requirements of the Basis of Design and the color and style are acceptable
   matches as approved by the Architect prior to bid opening. These
   additionally approved manufacturers and carpets will be included by
   Addendum.
   An unacceptable color match or style is reason for disapproval of product
   and manufacturer. No substitutions will be considered after bid opening.

C. Carpet Type CR-1 and CR-2
1. Carpet Properties
   a. Construction: Tufted, textured tip-shear
   b. Dye Method: Solution
   c. Face Fiber: 100% nylon.
   d. Tufted Face Weight: 28 oz/SY
   e. Gauge: 1/12
   f. Rows: 10.5/inch
   g. Finished Pile Height: 0.125 inch
   h. Density Factor: 403,428.
   i. Nominal Total Thickness: .36 inch
   j. Flammability (Radiant Panel ASTM E648): > 0.45 (Class I)
   k. Smoke Density (NFPA 258-T or ASTM E662): ≤ 450
2. Manufacturer and Style: MILLIKEN Paste Up; Tessellate
3. Colors: As indicated on the drawings.

D. Carpet Type CR-3
1. Carpet Properties
   a. Construction: Interloop
   b. Finished Weight: 103 oz/SY
   c. Face Fiber: 100% nylon.
   d. Tufted Face Weight: 28 oz/SY
   e. Gauge: 5/64
   f. Finished Pile Height: 0.126 inch
   h. Average Density 7,448.
   g. Nominal Total Thickness: .36 inch
   h. Flammability (Radiant Panel ASTM E648): > 0.45 (Class I)
   i. Smoke Density (NFPA 258-T or ASTM E662): ≤ 450
2. Manufacturer and Style: ATLAS Dongara
3. Color: As indicated on the drawings.

E. Carpet Type CR-4

1. Carpet Properties
   a. Construction: Interloop
   b. Finished Weight: 101 oz/SY
   c. Face Fiber: 100% nylon.
   d. Tufted Face Weight: 26 oz/SY
   e. Gauge: 5/64
   f. Yarn Pile Height: 0.103 inch
   g. Average Density: 8,338.
   h. Nominal Total Thickness: .36 inch
   i. Flammability (Radiant Panel ASTM E648): > 0.45 (Class I)
   j. Smoke Density (NFPA 258-T or ASTM E662): < 450

2. Manufacturer and Style: ATLAS Arnhem

3. Color: As indicated on the drawings.

2.02 WALK-OFF CARPET TILE MAT

A. Carpet Properties/Manufacturer WM-1

1. Pattern: Super Flor 6090002504.
2. Face Yarn: 82.5% nylon; 17.5% polyester
4. Finished Pile Thickness: .325"
5. Colors: As indicated on the drawings.
6. Manufacturers
   a. Basis of Design: INTERFACE.
   b. Other Acceptable Manufacturers: Carpet manufactured by ATLAS or MILLIKEN will be considered if materials meet the requirements of the Basis of Design and the color and style are acceptable matches as approved by the Architect prior to bid opening. It is anticipated that a custom carpet by these manufacturers will be required. These additionally approved manufacturers and carpets will be included by Addendum. An unacceptable color match or style is reason for disapproval of product and manufacturer. No substitutions will be considered after bid opening.

2.03 CARPET PADDING DOUBLE GLUE DOWN

A. Description: High density styrene-butadiene rubber carpet cushion designed for double direct glue installation.

B. Fire Test: Passes Methenane Pill Test (DOC-FF1-70 FF2-70).

C. Physical Characteristics
   1. Density: 22 pounds per cubic foot.
   2. Thickness: .25".
   3. Profile: Flat.

D. Manufacturer: Tred-Mor #2568-2 by SPONGE-CUSHION, INC. or equal by AMOCO FABRICS AND FIBERS or CARPET CUSHION ASSOCIATES.
2.03 CARPET PADDING STRETCH-IN

A. Description: Grafted or densified primed bonded polyurethane-foam cushion.

B. Compression Force Deflection at 65 Percent per ASTM D 3574: 0.7 to 1.4 and as recommended by carpet manufacturer

C. Physical Characteristics: HUD/FHA UM72a Class: 1
1. Density: 6 lbs.
2. Polymer density lbs./cu. Ft. ±5% 2.2 to 2.7
3. Thickness: .375".
4. Profile: Flat.
5. Tensile Strength psi min: 10
6. Elongation %: 100
7. Comp. Set Max. % At 50% Deflection: 15.0

D. Emissions: Provide carpet cushion that complies with testing and product requirements of CRI's "Green Label" program.

2.04 ACCESSORIES

A. Carpet Edge Guard: Non-metallic type. Extruded or molded vinyl or rubber of size and profile indicated. Color as selected by Architect.

B. Adhesive: Non-toxic, waterproof, white latex base cement formulated for the installation of the manufactured materials. Type as recommended by carpet manufacturer.
1. Toxicity/IEQ: Adhesive must not have a VOC content greater than 50 g/L less water and exempted solids, as prescribed by South Coast Air Quality Management District Rule 1168.

B. Adhesive
1. Type 1: Pressure sensitive type for use between floor and pad.
   a. Manufacturer: Fultack TA-715 by H.B. FULLER; Parabond-M277 by PARA-CHEM; Release Stix #2230 by XL CORP; D2 by USG-DURABOND or equal.

2. Type 2: Premium quality carpet adhesive for use between carpet and pad. Waterproof, non-flammable type.
   a. Manufacturer: Perfect Puddown TA717 by H.B. FULLER; Parabond Commercial Grade - M433 by PARA-CHEM; Premium Multi-purpose Gold Stix #90 by XL CORP.; Floor Covering Adhesive D600 by USG-DURABOND or equal.

C. Seaming Cement: Hot-melt seaming adhesive or similar product recommended by carpet manufacturer, for taping seams and buttering cut edges at backing to form secure seams and prevent pile loss at seams.

D. Miscellaneous Materials: As recommended by manufacturer of carpet and other carpeting accessory products; selected by installer to meet project circumstances and requirements.

E. Leveling Materials and Crack Fill: Non-staining latex cementitious type, compatible
with carpet adhesive, as recommended by the flooring manufacturer.

F. Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.

G. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

2.04 WALL CARPET

A. Manufacturer: Specifications are based on Tretford by EUROTEX or equal products by GENERAL FELT INDUSTRIES or MODERN CARPET INDUSTRIES conforming to the following:

2. Face Yarn: 80% goat hair, 15% nylon, 5% viscose.
3. Primary Backing: PVC.
5. Width: 6'-7".
6. Thickness: 1/4".
7. Total Weight: 80 ounce per square yard.
8. Flame Spread: Class A per ASTM E84.
9. Smoke Developed: Class A per ASTM E84.
10. NRC: .20 per ASTM C423.
11. Colors: As selected by Architect.

PART 3 EXECUTION

3.01 PREPARATION

A. Installer must examine substrates for moisture content and other conditions under which carpeting is to be installed, and notify Contractor in writing of conditions detrimental to proper completion of the work.

1. Do not proceed until unsatisfactory conditions have been corrected.

B. Comply with CRI 2011 and with carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.

C. Concrete Substrates

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by flooring manufacturer. Do not use solvents.
3. Perform tests recommended by flooring manufacturer. Proceed with installation only after satisfying manufacturer’s recommendations for test results.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and
patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Sequence carpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period.

3.02 INSTALLATION

A. Install in accordance with recommendations of the manufacturers of materials and Carpet and Rug Institute's methods specified in CRI 2011. Carpet manufacturer's current installation instructions shall be kept at job site and be followed explicitly.

1. Comply with manufacturer's recommendations for installation of carpet; maintain uniformity of carpet direction and lay of pile, unless otherwise indicated.

2. [Stretch-in Installation: Comply with CRI 104, Section 12, "Stretch-in Installations."

B. Use modular carpet from the same dye lot in each room.

C. Lay carpet in accordance with the final shop drawings. No reversing of carpet direction shall be permitted.

D. Install modular carpet by trimming, cutting and prefitting units. Then apply adhesive in strict accordance with manufacturer's instructions, and place the carpet modules with the pile inclination in the direction as recommended by the manufacturer, or as otherwise indicated on the final layout drawings.

1. Application shall be full spread. Sprayed on adhesive is not permitted.

2. Install using a notched trowel.

E. Trim protruding ends of open loops so slightly below surrounding pile height.

F. Use edge molding where carpet terminates under doors and along edge of carpet where it abuts another floor material. Fasten edge moldings securely to the floor with glue manufactured for this specific purpose.

G. Roll entire area lightly to eliminate air pockets and ensure uniform bond.

[H. Double Glue-Down Installation

1. Layout cushion using the longest lengths possible.

2. Locate seams of carpet so they are not directly over cushion seams.

3. Butt cushion edges.

4. Place cushion in full bed of adhesive conforming to application and curing rates of adhesive.

5. Fit sections of carpet into each space prior to application of adhesive. Trim edges and butter cuts with seaming cement.

6. Apply adhesive uniformly to cushion in accordance with manufacturer's
instructions. Butt carpet edges tightly together to form seams without gaps. Roll lightly to eliminate air pockets and ensure uniform bond. Remove adhesive promptly from face of carpet.]

[I. Wall Carpet Installation
   1. Apply with adhesive as recommended by manufacturer.
   2. "Back-tack" sheets along top; remove tacks when adhesive has dried.
   3. Lightly roll each sheet with a vinyl roller.
   4. Install with rib running vertically.]

3.03 CLEANING AND PROTECTION

A. Protect installed carpet to comply with CRI 2011 and carpet manufacturer recommendations.

B. Remove debris, sorting pieces to be saved from scraps to be disposed. Keep premises free and clear of waste material in connection with carpet work.

C. Vacuum carpet using commercial machine with face-beater element. Remove spots and replace carpet where spots cannot be removed.

D. Advise Contractor of protection methods and materials needed to ensure that carpeting will be without deterioration or damage at time of substantial completion.

E. Provide adequate protection for adjacent equipment, furnishings and materials.

[F. When entering, passing through, or working in any space in the building that contains finished materials, maintain proper protection for floors, walls, ceilings, fixtures, etc. Repair or replace damaged adjoining work as directed by the Architect at no additional cost to the Owner.]

END OF SECTION
SECTION 09 77 26

PRESENTATION (DRY ERASE) WALLCOVERING

PART 1  GENERAL

1.01  SUMMARY

A. Section Includes Dry erase wallcovering and Accessories.

1.02  RELATED SECTIONS

A. Wood Trim: Section 06 20 00.
B. Painting: Preparation and priming of substrate surfaces. Section 09 91 00.

1.03  REFERENCES

A. American Society for Testing and Materials (ASTM):
   2. D751: Methods of Testing Coated Fabrics.
B. Underwriters Laboratory, Inc.: UL 723 - Test for Surface Burning Characteristics of Building Materials
C. Gypsum Association: GA-14-M-97 - Recommended Levels of Gypsum Board

1.04  SUBMITTALS

A. Submit manufacturer’s product data and installation instructions for dry erase wallcovering, adhesive and accessories.
B. Submit manufacturer's written installation instructions.
C. Submit manufacturer's written instructions for recommended maintenance of dry erase wallcovering required. Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.
D. Samples: Submit 7-inch by 9-inch sample of dry erase material.

1.05  QUALITY ASSURANCE

A. Applicator: Skilled commercial wallcovering applicators with no less than three years of documented experience installing dry erase wallcovering of the types and extent required.
B. Fire Hazard Classification: Provide materials that comply with NFPA Class A fire rating when tested in accordance with ASTM E84 using GRC Board as substrate. Identify components with markings from testing and inspection organization.
C. Field Samples: Prepare field samples for Architect’s review and establish
requirements for seaming and finish trim.
1. Install sample panel of each type presentation wallcovering specified in area designated by Architect.
2. Maintain corrected and approved samples to serve as a standard of performance for the project.
3. Approved field sample may become part of the completed project.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver presentation wallcoverings to the project site in unbroken and undamaged original factory wrappings and clearly labeled with the manufacturer's identification label, quality or grade, and lot number.

B. Store materials in a clean, dry storage area with temperature maintained above 55 degrees F with normal humidity.

C. Store material in a flat position to prevent damage to roll ends. Do not cross stack material. Support material off the floor in a manner to prevent sagging and warping.

1.07 PROJECT CONDITIONS

A. Do not apply presentation wallcoverings when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.

B. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 55 degrees F unless required otherwise by manufacturer's instructions.

C. Apply adhesive when substrate surface temperature and ambient temperature is above 55 degrees F and relative humidity is below 40 percent.

D. Maintain constant recommended temperature and humidity for at least 72 hours prior to and throughout the installation period, and for 72 hours after wallcovering installation completion.

E. Provide not less than an 80 foot-candles per square foot lighting level measured mid-height at substrate surfaces.

1.08 WARRANTY

A. Submit manufacturer's limited five-year written warranty against manufacturing defects.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Drawings and specifications are based on Walltalkers Wallcoverings manufactured by RJF INTERNATIONAL CORPORATION.

B. Other Manufacturers: Products from other manufacturers will be considered if
materials meet the requirements specified as approved by the Architect prior to bid opening. These additionally approved manufacturers will be included by Addendum. No substitutions will be considered after bid opening.

2.02 MATERIALS

A. Composition: Provide polyester scrim backing, pigmented vinyl capped with Teflon dry erase film.

B. Model: Walltalkers just•rite: Moderate gloss vinyl surface for dry erase markers. JR48; 21 ounce per square yard, woven backing.

C. Size: 48-inch width by continuous length as indicated on the drawings.

2.03 ACCESSORIES

A. Adhesives: Heavy-duty clear premixed vinyl adhesive or clay based adhesive.

B. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.

C. Wood Trim: See Section 06 20 00. Oak wood trim; stain color as selected by Architect.

D. Presentation Starter Kits: Provide one Walltalkers starter kit containing eight dry erase markers, two erasers, 10 cleaning towels, and one 8 ounce bottle liquid surface cleaning solution for each room installed with dry erase wallcovering.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 4 finish, GA-214-M-97, Recommended Levels of Gypsum Board Finish.

B. Test substrates with a suitable moisture meter and verify that moisture content does not exceed 4 percent.

C. Verify substrate surfaces are clean, dry, smooth, structurally sound and free from surface defects and imperfections that would show through the finished surface.

D. Evaluate all painted surfaces for the possibility of pigment bleed-through.

E. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.

F. Beginning of installation means acceptance of surface conditions.

3.02 INSTALLATION

A. Acclimate wallcovering in the area of installation a minimum of 24 hours before
installation.

B. Examine all materials for color, quantity and quality as specified for the correct location prior to cutting.

C. Read and follow the instructions in the manufacturer's installation sheet contained in each roll of the dry erase wallcovering.

D. Install each roll in sequence starting from the highest to the lowest number and each strip in the same sequence as cut from the roll.

E. Install dry erase wallcovering panels in exact order as they are cut from bolt. Reverse hang alternate strips. Do not crease the wallcovering.

F. To allow air bubble movement and removal of double cut waste at the seams of self-adhesive wall covering, pre-wet surface with solution of ½ capful of mild detergent to 2 gallons clean water.

G. Using a soft natural sponge or lint free towel, lightly dampen the surface to be covered. Dampen seam areas more.

H. Smooth wall covering to the hanging surface using a wallcovering smoother, wrapped with a soft cloth, or hands using a downward and outward motion to eliminate air bubbles, wrinkles, gaps and overlaps.

I. Stop installation of material that is questionable in appearance and notify the manufacturer's representative for an inspection.

### 3.02 CLEAN-UP

A. Upon completion of installation, wash the wall covering with an ammonia or alcohol-based cleaner or mild soap rinse thoroughly with water prior to using.

B. Upon completion of the work, remove surplus materials, rubbish and debris resulting from the wallcovering installation. Leave areas in neat clean and orderly condition.

END OF SECTION
SECTION 09 77 27

TACKABLE WALLCOVERING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes resilient cork/linoleum tackable wallcovering and accessories.

1.02 RELATED SECTIONS

A. Painting: Preparation and priming of substrate surfaces. Section 09 91 00.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):
   2. D751: Methods of Testing Coated Fabrics.

B. Underwriters Laboratory, Inc.: UL 723 - Test for Surface Burning Characteristics of Building Materials

C. Gypsum Association: GA-14-M-97 - Recommended Levels of Gypsum Board

1.04 SUBMITTALS

A. Submit manufacturer’s product data and installation instructions for wallcovering, adhesive and accessories.

B. Submit manufacturer's written installation instructions.

C. Submit manufacturer's written instructions for recommended maintenance of wallcovering required.
   1. Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

D. Samples: Submit 7-inch by 9-inch sample of tackable wallcovering material.

1.05 QUALITY ASSURANCE

A. Applicator: Skilled commercial wallcovering applicators with no less than three years of documented experience installing tackable wallcovering of the types and extent required.

B. Fire Hazard Classification: Provide materials that comply with NFPA Class A fire rating when tested in accordance with ASTM E84 using GRC Board as substrate. Identify components with markings from testing and inspection organization.

C. Field Samples: Prepare field samples for Architect's review and establish requirements for seaming and finish trim.
   1. Install sample panel of each type presentation wallcovering specified in
area designated by Architect.

2. Maintain corrected and approved samples to serve as a standard of performance for the project.

3. Approved field sample may become part of the completed project.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver presentation wallcoverings to the project site in unbroken and undamaged original factory wrappings and clearly labeled with the manufacturer's identification label, quality or grade, and lot number.

B. Store materials in a clean, dry storage area with temperature maintained above 55 degrees F with normal humidity.

C. Store material in a flat position to prevent damage to roll ends. Do not cross stack material. Support material off the floor in a manner to prevent sagging and warping.

1.07 PROJECT CONDITIONS

A. Do not apply presentation wallcoverings when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.

B. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 55 degrees F unless required otherwise by manufacturer's instructions.

C. Apply adhesive when substrate surface temperature and ambient temperature is above 55 degrees F and relative humidity is below 40 percent.

D. Maintain constant recommended temperature and humidity for at least 72 hours prior to and throughout the installation period, and for 72 hours after wallcovering installation completion.

E. Provide not less than an 80 foot-candles per square foot lighting level measured mid-height at substrate surfaces.

1.08 WARRANTY

A. Submit manufacturer's limited five-year written warranty against manufacturing defects.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Subject to requirements, Walltalkers Tac•Wall Wallcoverings manufactured by RJF INTERNATIONAL CORPORATION, Tack-A-Cork manufactured by MARKA WALL, FORBO Tackable Cork Surface or ALPHASORB are acceptable.

2.02 MATERIALS

A. Uni-color, resilient, homogeneous, tackable linoleum surface consisting of linseed oil, granulated cork, rosin binders, and dry pigments calendared onto
natural burlap backing. Color shall extend through thickness of material.

B. Size: 48-inch width by continuous length as indicated on the drawings.

C. Thickness: ¼”.

2.03 ACCESSORIES

A. Adhesives: Heavy-duty clear premixed vinyl adhesive or clay based adhesive. VOC compliant.

B. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions in which tackable wallcoverings will be installed.
   1. Complete finishing operations, including painting, before beginning installation of tackable wallcovering materials.
   2. Wall surfaces to receive wallcovering materials shall be dry and free from dirt, grease, loose paint, and scale.
   3. Do not proceed with installations until satisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Remove hardware, accessories, plates, and similar items to allow tackable wallcovering to be installed.
   2. Painted surface: Remove loose paint or scale. Sand surface of enamel or gloss paint and wipe clean with damp cloth.
   3. Ensure gypsum wallboard surfaces scheduled to receive wallcovering are properly primed with a quality acrylic wallcovering primer under Section 09 91 00.

B. Prime substrate as recommended by manufacturer.

3.02 INSTALLATION

A. Comply with manufacturer’s printed installation instructions.

B. Cut sheets to size including 2 to 3 inches of overage. Allow sheets to lay flat for at least 24 hours prior to the application. Mark roll direction and sequence on the backside of each sheet. Hang sheets in sequence as cut from the roll, do not reverse sheets.

C. Permanent HVAC system should be set to 68˚ F for at least 72 hours prior to, during, and after the installation.

D. Back roll each sheet prior to the installation to release curl memory.
E. For seamed applications, using a seam and strip cutter remove the factory edge of one sheet. Using the same tool, overlap and trace cut the mating edge of the second sheet. Repeat this step for as many sheets as required for the job.

F. Scribe, cut, and fit material to butt tightly to adjacent surfaces, built-in casework, and permanent fixtures and pipes.

G. Apply adhesive (only enough to hang one sheet at a time) with a 1/16 inch trowel to the area to receiving the sheet.

H. Work from top to bottom then side to side. Roll sheet firmly into adhesive for positive contact and to remove air bubbles.

I. Remove adhesive residue immediately after each panel is hung with a mild soap/water solution and a soft cloth/spoon.

3.02 CLEAN-UP

A. Protect installed product and finish surfaces from damage during construction.

B. Upon completion of the work, remove surplus materials, rubbish and debris resulting from the wallcovering installation. Leave areas in neat clean and orderly condition.

END OF SECTION
PART 1 GENERAL

1.01 SCOPE

A. Work Included

1. Surface preparation and painting or finishing of all interior and exterior exposed items and surfaces except as otherwise indicated. Work includes, but is not necessarily limited to, the following:
   a. Walls, ceilings and soffits of gypsum board.
   b. Concrete masonry walls; exterior concrete.
   c. Hollow metal doors and frames.
   d. Wood trim, casework and millwork as required.
   e. Exposed structure including deck and all framing.
   f. Exposed ferrous metal of any type, interior and exterior, including galvanized items.
   g. Exposed sheet metal, ductwork, conduit and piping in finished spaces; not mechanical equipment or electrical equipment rooms.
   h. Exposed prime coated or unfinished mechanical or electrical items outside of mechanical equipment rooms. Repaint factory finished mechanical or electrical items where specified.
   i. Stenciling of fire walls above ceilings.
   j. Paint existing surfaces and items where indicated on the drawings and where these surfaces and items are located within areas where new work is being performed.
   k. Exposed cementitious fireproofing.
   l. Other items noted or specified.

2. Surface preparation, priming and coats of paint specified are in addition to shop priming and surface treatment specified in other sections of the work.

B. Mechanical Equipment Rooms: Painting subject to the following requirements:

1. Paint finish on walls and ceiling, when scheduled on drawings, to be applied prior to installation of MPE work as much as possible.
2. Spray painting not permitted after electric motors have been installed.

C. Work Excluded: Do not paint the following items unless specifically called for on the drawings or specified herein:

1. Concrete floors.
2. Shop or prime coats on items to which shop or prime coats have been applied by the fabricator, unless noted otherwise.
3. Items with factory finish or natural finish (brick, stone, stainless steel, aluminum, and others) unless specifically noted elsewhere.
4. Colored concrete masonry units.
5. Wall areas permanently concealed by fixed equipment or accessories.
6. Sprayed fireproofing and items receiving sprayed fireproofing.
7. Equipment, sheet metal, ductwork and equipment in mechanical and electrical rooms; painting of these items, if required, provided under
8. Piping in mechanical rooms, except exposed gas and fire protection piping.
10. Factory finished equipment, except for touch-up, unless otherwise specified
11. Concealed piping.
12. Items permanently concealed above ceilings.

D. Surface Preparation
1. It is the intention of this specification that new substrates will be ready for
decoration as specified except for normal construction dust and soiling.
2. New surfaces installed by other trades are required to be acceptable for
work specified under Part 3, Surface Preparation. New surfaces to be
clean, sound, free from loose particles, dirt, loose mortar and grease.
3. Existing Surfaces: Unless otherwise specified, provide all surface
preparation required for decoration.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms,
furred spaces, pipe and duct shafts, unheated spaces immediately below roof,
spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include
finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor
ambient temperatures and weather conditions. Examples include rooftop
locations.

D. Concealed, Interior Installations: Concealed from view and protected from
physical contact by building occupants. Examples include above ceilings and in
duct shafts.

E. Concealed Exterior Installations: Concealed from view and protected from
weather conditions and physical contact by building occupants, but subject to
outdoor ambient temperatures. Example: installations within unheated shelters

1.03 QUALITY ASSURANCE

A. Application: Performed only by skilled, experienced painters.

B. Provide lead free prime and finish coatings. All top coatings shall be mold and
mildew resistant.

C. Coordination: Provide finish coats compatible with prime paints used. Review
other specification sections to ensure compatibility of total coating system with
prime paints provided for the various substrates. Provide barrier coats over non-
compatible primers or remove primer and reprime as required. Notify the Architect
of anticipated problems using coating systems specified on substrates primed in
accordance with other section requirements.
D. Reference Specifications
   1. The following Society for Protective Coatings (SSPC) specifications are referenced by code number within this Section.

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<thead>
<tr>
<th>Code</th>
<th>Method</th>
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<tbody>
<tr>
<td>SP-1</td>
<td>Solvent Cleaning</td>
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<td>SP-2</td>
<td>Hand Tool Cleaning</td>
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<td>SP-3</td>
<td>Power Tool Cleaning</td>
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<td>SP-6</td>
<td>Commercial Blast Cleaning</td>
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<tr>
<td>SP-11</td>
<td>Power Tool Cleaning to Bare Metal</td>
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E. Job Mock-Ups: Mock-ups will serve as standard for acceptance of work. Leave approved mock-ups in place as part of completed project. Manufacturers' representatives shall be available to advise applicator on proper application techniques and procedures. Locate mock-up areas as directed by Architect. Provide the following mock-ups of spaces or areas indicated:
   1. Concrete Masonry, Epoxy Coating: 50 square feet.
   2. Concrete Masonry, Painted Finish: 50 square feet.
   4. Gypsum Board, Painted Finish: Mock-up room walls complete as specified in Section 09 21 16.
   5. Ductwork: 6 linear feet of each paint type.

F. Paint walls prior to installing wall mounted signage.

G. Pre-painting Walk-Thru: In areas where ceilings and walls are scheduled or indicated to be field painted, and equipment, ductwork, piping, conduit and other wall/ceiling mounted or suspended items are exposed, the areas are to be reviewed to determine colors of the various items.

1.04 SUBMITTALS

A. Submit a complete selection of manufacturer's color chips indicating color, texture and sheen for approval for each finish specified herein.

B. Submit a complete schedule for identifying manufacturer and specific brand name or number of products proposed for finishing specified surfaces.
   1. Provide percent of solids by volume content data for each paint material.
   2. Provide paint label analysis and application instructions for each type paint.

C. Provide one (1) unopened gallon of each type and color of paint and stain required for maintenance purposes. Provide original, unopened, labeled containers with color samples and a list of project use. Extra materials are not to be used for touch-up by Contractor.

D. Color/Finish Samples
   1. After receiving color chips from the Contractor, the Architect will provide a complete schedule of colors and sheens desired.
   2. Obtain schedule well in advance of commencing work and submit samples of specified finishes for approval.
   3. Submit duplicate samples on the same kind of materials to which finishes will be applied. One half of the sample shall show the completed treatment
and the other half shall show the successive steps, taken in producing the finish. When approved, samples will be so marked; one set will be retained by the Architect and one set will be returned for the painter's use.

4. No finishes shall be applied on the work until samples are approved. Approved samples shall be strictly duplicated in the work. Additional coatings, if required to reproduce approved samples, shall be applied without additional cost to the Owner.

5. Use representative colors when preparing samples for Architect's review.

E. Statement From Manufacturer

1. Contractor, in submitting the list of proposed subcontractors, shall include for approval, along with the name of the painting subcontractor, the names of the manufacturers whose materials the subcontractor proposes to use in the work.

2. Following tentative approval of the subcontractor and the materials manufacturers, notify the manufacturers, in writing, that the specifications require the manufacturers to submit to the Architect, a statement by a corporate officer of the manufacturer that coatings scheduled by the Architect are proper for the intended use and that the manufacturer's representative will be available to advise the Architect and the Contractor regarding applications of all coatings.

3. **Coating Maintenance Manual**: Upon conclusion of the project, the Contractor or paint manufacturer / supplier shall furnish a coating maintenance manual (*equivalent to the Sherwin-Williams “Custodian Project Color and Product Information” report*). Manual shall include an area summary with finish schedule; area detail designating where each product/color/finish was used; product data pages; Material Safety Data Sheet (MSDS); care and cleaning instructions and touch-up procedures.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials on the job site in original, new, unopened packages and containers bearing the manufacturer's name and label, and the following information:

1. Name or title of material.
2. Manufacturer's stock number and date of manufacture.
3. Manufacturer's name.
4. Contents by volume, for major pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.

B. Store, protect and handle materials in accordance with manufacturer's recommendations to prevent damage and deterioration. Store paint materials at minimum of 50°F.

C. Maintain paint material storage space as clean, non-hazardous and orderly. Place waste and soiled paint rags in tightly covered metal containers; safely dispose of at end of each working day. Take every precaution to avoid fire hazards and spontaneous combustion. Provide acceptable type of fire extinguisher immediately adjacent to paint storage area.
1.06  PROJECT CONDITIONS

A. Coordinate painting and finishing work with other trades to ensure adequate illumination, ventilation and dust-free environment during application and drying of paint and finish treatments.

B. Maintain uniform interior building temperature of minimum 50° F for 24 hours before, during and continuously for 48 hours after painting.

C. Do not apply coatings when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Provide adequate ventilation as required for specified paint and finish treatment materials in spaces scheduled. Maintain for time periods recommended by material manufacturer to provide proper drying.

E. Provide adequate illumination on surfaces to be finished. Maintain a minimum 80 foot candle lighting level measured mid-height at substrate surface.

F. Protect adjoining surfaces against damage or soiling.

G. Maintain work in neat and orderly condition, promptly removing empty containers, wrappings, soiled rags, waste and rubbish from site.

H. Material Safety Data Sheets (MSDS): Provide documents available to Owner's Representative, Architect and construction personnel at the job site. Comply with MSDS requirements.

PART 2  PRODUCTS

2.01  ACCEPTABLE MANUFACTURERS

A. Paint: SHERWIN WILLIAMS; FARRELL-CALHOUN; PPG and AKZO NOBEL (Glidden Professional and Devoe Coatings) brands of paint and stain are specified in "Paint and Material Finish Schedule," only to establish a standard of quality. Other paint brands and manufacturers such as; BENJAMIN MOORE; MARTIN SENOUR; PRATT and LAMBERT; PORTER; CORONADO PAINT COMPANY are acceptable upon proof of satisfactory experience records for the intended use and compliance with specified VOC content; colors as indicated on drawing or as selected by Architect.

B. Secondary products not specified by name (i.e. turpentine, thinners, mineral spirits, fillers, linseed oils, etc.) shall be "best grade" or "first line" products.
   1. Filler material shall be woodworker's option of material that can be tinted and worked so as to match adjacent wood surfaces.

C. Special Coatings: TNEMEC brand of coatings are specified in "Coatings and Material Finish Schedule," to establish a standard of quality. Coatings manufactured by DuPONT, INTERNATIONAL PROTECTIVE COATINGS or CARBOLINE are acceptable upon proof of satisfactory experience records for the intended use. Colors as indicated on drawing or as selected by Architect.
2.02 MATERIAL QUALITY

A. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

B. Material Compatibility

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Stains: Factory-mixed, penetrating, transparent oil-base type. Applicator shall be allowed to add approved colorants on the job to match approved samples. No other ingredients shall be added to stains.

2.03 ACCESSORY MATERIAL

A. Application Equipment: Not required to be new, but shall be adequate for the work and workmanship required herein.

B. Accessories: Provide all required ladders, scaffolding, drop cloths, masking, scrapers, tools, dusters and cleaning solvents as required to perform the work and achieve the results specified herein.

2.04 EXTERIOR PAINT AND FINISH MATERIAL SCHEDULE

A. Apply paint and finish materials to substrate surfaces indicated. Apply touch-up prime coats in addition to shop-applied prime coats. Provide additional job site prime coats when indicated.

B. Metals-Ferrous: Galvanized & Shop Primed (Semi-Gloss): (Acrylic Latex System)

1. SW
2. PPG  
3. GLIDDEN PROFESSIONAL  
4. FARRELL-CALHOUN  
a. Finish: Tuff Boy Waterborne 100% Acrylic DTM Enamel 8000 Line. Two (2) coats.  
5. Galvanized Metals: Provide pretreatment as specified herein.  
C. Metal – Ferrous: Unprimed (Semi-Gloss): (Acrylic Latex System),  
1. SW  
b. Finish: S-W Metalatex Semi-Gloss Enamel B42 Series. (2) coats  
c. Optional Finish: S-W Direct-to-Metal DTM Acrylic Semi-Gloss Coating, B66-200. Two (2) coats  
2. PPG  
3. GLIDDEN PROFESSIONAL  
a. Primer: Devflex 4020 Direct to Metal Primer; One (1) coat.  
b. Finish; Devoe Coatings Devflex 4216HP High Performance Acrylic Semi-Gloss 4216L Series. Two (2) coats.  
4. FARRELL-CALHOUN  
a. Primer: Tuff Boy 100% Acrylic DTM Primer 5-56. One (1) coat.  
b. Finish: Tuff Boy Waterborne 100% Acrylic DTM Enamel 8000 Line. Two (2) coats.  
D. Aluminum Shapes and Railings  
1. Surface Preparation: Clean surfaces of dirt, grease, loose rust, mill scale and other deleterious materials.  
2. SW  
a. Prime Coat: Pro Industrial Pro-cryl Universal Primer B66-310. One coat at 2.4 mils dft.; VOC 110 g/L.  
b. Finish Coat (All steel exposed to view): Waterbased Acrolon 100 Water Based Urethane B65 Series. Two coats at minimum 2.0-4.0 mil dft per coat. VOC <100 g/L.  
3. BENJAMIN MOORE  
a. Prime Coat: Waterborne Polyamid Epoxy Gray Primer Series M42. One (1) coat at 1.5 to 2.5 mils dft. 43% solids; VOC 136 g/L.  
b. Finish Coat (All Steel Exposed to View): Waterborne Urethane Semi-Gloss Finish Series M73S. Two (2) coats at 1.5 to 2.5 dft per coat. 38% solids; VOC 213 g/L.
4. **GLIDDEN PRO**
   a. **Prime Coat**: Devoe Coatings Devran 203 Waterborne Epoxy Primer. One (1) coat.
   b. **Finish Coat**: Devoe Coatings Devthane 379H Aliphatic Urethane Gloss Enamel. Two (2) coats.
5. **Colors**: As selected by Architect.
6. **Perforated Steel Panels**: Same finish; factory applied.
7. **Galvanized Metals**: Provide pretreatment as specified herein.

**E. Gypsum Board Soffits/Ceilings**
1. **SW**
   a. **Primer**: S-W A-100 Exterior Latex Primer B42 Series. 34% to 38% solids; VOC 89 g/L.
   b. **Finish**: A-100 Exterior Latex Flat Coating A6 Series. Two coats at 1.2 mils dft per coat. 34% solids; VOC <50 g/L.
2. **PPG**
   a. **Primer**: Seal Grip Interior/Exterior 100% Acrylic Universal Primer/Sealer 17-921 Series. One (1) coat at minimum 1.5 mils dft. 37% to 41% solids; VOC 89 g/L.
   b. **Finish**: Pitt-Cryl Exterior Wood and Stucco Flat Latex 10-6 Series. Two coats at minimum 1.2 mil dft. 36% to 40% solids; VOC 95 g/L.
3. **GLIDDEN PRO**
   a. **Primer**: Hydrosealer Exterior Primer Sealer 6001-1200. One coat.
   b. **Finish**: Fortis 450 Exterior Flat Paint 6201V Series; Two (2) coats.
4. **FARRELL-CALHOUN**
   a. **Primer**: Interior/Exterior 100% Acrylic Latex Undercoater 235. One (1) coat at 1.7 mils dft per coat. 41.3% volume solids; VOC 35 g/L.
   b. **Finish**: 100% Acrylic Exterior Flat Latex 200 Line. Two (2) coats at 1.9 mils dft per coat. 40.8% volume solids; VOC 45 g/L.

**2.05 INTERIOR PAINT AND FINISH MATERIALS SCHEDULE**

**A.** Apply paint and finish materials to substrate surfaces indicated. Apply touch-up prime coats in addition to shop-applied prime coats. Provide additional job site prime coats when indicated.

**B. Gypsum Board and Plaster – Walls, (Acrylic Latex System)**
1. **SW**
   a. **Primer**: ProMar 200 Zero VOC Interior Latex Primer, B28-2600 One (1) coat at 1.2 mils dft. 26% volume solids; VOC <50 g/L.
   b. **Finish**: ProMar 200 Zero VOC Interior Latex Eg-Shell B20-2600 Series. Two (2) coats at minimum 1.7 mil dft per coat. 42% volume solids; VOC 0 g/L.
2. **PPG**
   a. **Primer**: SpeedHide Interior Latex Primer 6-2 Series.
   b. **Finish**: Speedhide Zero 6-4310XI Series; latex eggshell. (2) coats
3. **GLIDDEN PRO**
   a. **Primer**: Lifemaster No VOC Interior Primer 9116-1200. One (1) coat.
   b. **Finish**: Lifemaster No VOC Interior Latex Eggshell Paint 9300 Series. Two (2) coats.
4. FARRELL-CALHOUN
   a. Primer: Perfik-Seal Interior Latex Primer/Sealer 380. One (1) coat at 1.8 mils dft. 39.2% volume solids; VOC 47 g/L.
   b. Finish: Evergreen Acrylic Interior Latex Eggshell Enamel 3900 Line. Two (2) coats at 1.8 mils dft per coat. 39% volume solids; VOC 0 g/L.

5. Surfaces: Gypsum board wall surfaces.

C. Gypsum Board – Walls, Epoxy
   1. SW
      a. Primer: ProMar 200 Zero VOC Interior Latex Primer. One coat at 1.2 mil dft. 26% solids; VOC 0 g/L.
      b. Finish: SW Water Based Catalyzed Epoxy B70 Series. Two coats at minimum 2.5 to 3.0 mils dft per coat. Semi-gloss. VOC <200 g/L; 39% solids.

   2. PPG
      a. Primer: Seal Grip Interior/Exterior 100% Acrylic Universal Primer/Sealer 17-921 Series. One (1) coat at minimum 1.5 mils dft. 37% to 41% solids; VOC 89 g/L.
      b. Finish: Pitt-Glaze Water Base Acrylic Epoxy Semi-Gloss 16-551 Series. Two (2) coats at 2.3 to 2.7 mils dft per coat. 44% to 48% solids; VOC <183 g/L.

   3. GLIDDEN PRO

   4. FARRELL-CALHOUN
      a. Primer: Perfik-Seal Interior Latex Primer/Sealer 380. One (1) coat at 1.8 mils dft. 39.2% volume solids; VOC 47 g/L.
      b. Finish: Tuff Boy 100% Acrylic Waterborne Epoxy 1200WB. Two (2) coats at 2.2 mils dft per coat. 41% volume solids; VOC 99 g/L.

5. Surfaces: Where indicated.

D. Gypsum Board and Plaster - Ceilings and Soffits (Acrylic Latex System)
   1. SW
      a. Primer: ProMar 200 Zero VOC Interior Latex Primer B28-2600. One (1) coat at 1.2 mils dft. 26% volume solids; VOC 0 g/L.
      b. Finish: ProMar 200 Zero VOC Interior Latex Flat B30-2600 Series. Two (2) coats at minimum 1.6 mil dft per coat. 39% volume solids; VOC 0 g/L.

   2. PPG
      a. Primer: SpeedHide Interior Latex Primer 6-2 Series.
      b. Finish: Speedhide Zero 6-4110XI Series; latex flat. Two (2) coats.

   3. GLIDDEN PRO
      a. Primer: Lifemaster No VOC Interior Primer 9116-1200. One (1) coat.
      b. Finish: Lifemaster No VOC Interior Latex Flat Paint 9100 Series. Two (2) coats.

   4. FARRELL-CALHOUN
      a. Primer: Perfik-Seal Interior Latex Primer/Sealer 380. One (1) coat at 1.8 mils dft. 39.2% volume solids; VOC 47 g/L.
b. Finish: Interior Premium Flat Latex 300 Line. Two (2) coats at 1.7 mils dft per coat. 36.5% volume solids; VOC 46 g/L.

5. Surfaces: Ceilings, soffits, bulkheads.

E. Concrete Masonry Surfaces (Semi-Gloss): (Vinyl Acrylic Latex System)
1. SW
   a. Filler: Preprite Block Filler B25W25. Minimum 8 mil dft to pin hole free. 48% to 52% solids; VOC 42 g/L. Optional Filler: Heavy Duty Block Filler, B42W46 10-18 mil dft, 53% solids, VOC <100 g/L
   b. Finish: ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series. Two (2) coats at minimum 1.6 mil dft per coat. 38% volume solids; VOC 0 g/L.

2. PPG
   a. Filler: Speedhide Block Filler Latex 6-7 Series. Minimum 8.5 mil dft to pin hole free.

3. GLIDDEN PROFESSIONAL
   b. Finish: Lifemaster Semi-Gloss 9200 Series. Two (2) coats.

4. FARRELL-CALHOUN
   a. Filler: Interior/Exterior Latex Masonry Block Filler 470. Minimum 8 mils dft to pin hole free. 46.7% volume solids; VOC 20 g/L
   b. Finish: Evergreen 100% Acrylic Interior Semi-Gloss Enamel 3300. (2) coats at 2.0 mils per coat. 38% volume solids; VOC <5 g/L.

5. Surfaces: New walls, graphics (do not use in high humidity areas)

F. Concrete Masonry Surfaces (Semi-Gloss): Epoxy.
1. SW
   a. Filler: Heavy Duty Block Filler, B42W46. 10-18 mil dft. 53% solids; VOC <100 g/L.
   b. Finish: SW Water Based Catalyzed Epoxy B70 Series. Two coats at minimum 2.5 to 3.0 mils dft per coat. Semi-gloss. VOC 209 g/L; 37% to 41% solids.

2. PPG
   a. Filler: Speedhide Int/Ext Acrylic Masonry Block Filler 6-15 Series. Minimum 8 mils dft to pin hole free.

3. GLIDDEN PRO
   a. Primer: Devoe Coatings Bloxfil 4000 Interior/Exterior Heavy Duty Acrylic Blockfiller, 4000-1000. Minimum 8 mils dft to pin hole free.

4. FARRELL-CALHOUN
   a. Primer: Interior/Exterior Acrylic Latex Masonry Block Filler 470A. Minimum 8 mils dft to pin hole free. 50% volume solids; VOC 35 g/L
   b. Finish: Tuff Boy 100% Acrylic Waterborne Epoxy 1200WB. Two (2) coats at 2.2 mils dft per coat. 41% volume solids; VOC 99 g/L.

5. Surfaces: Where indicated.
G. Metals - Ferrous: Shop Primed and Unprimed. (Acrylic Latex System)

1. SW
a. Primer: Direct-to-Metal DTM Acrylic Primer B66W1. 2.5 mils dft. 46% solids; 138 g/L.
   Optional primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 2.0-4.0 mil dft, 36% solids, VOC <100 g/l
b. Finish: ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series. Two (2) coats at minimum 1.6 mil dft per coat. 39% volume solids; VOC 0 g/L.
   Optional Upgrade Finish: Pro Industrial High Performance Acrylic S/G, B66-650 Series, 2.5 - 4.0 mil dft, VOC <50 g/l

2. PPG

3. GLIDDEN PROFESSIONAL
a. Primer: Devoe Coatings Devflex 4020PF Direct to Metal Primer/Finish 4020.
b. Finish: Lifemaster No VOC Interior Latex Semi-Gloss Paint 9200 Series. Two (2) coats.

4. FARRELL-CALHOUN
a. Primer: Tuff Boy 100% Acrylic DTM Primer 5-56. One (1) coat at 1.8 mils dft. 39% volume solids; VOC 45 g/L.
b. Finish: Evergreen 100% Acrylic Interior Semi-Gloss Enamel 3300. Two (2) coats at 2.0 mils per coat. 38% volume solids; VOC <5 g/L.

5. Surfaces: Hollow metal doors, frames, door mullions, railings, ferrous metal.

H. Metals - Ferrous: Galvanized. (Acrylic Alkyd System),

1. SW
a. Primer: Direct-to-Metal DTM Acrylic Primer B66W1. 2.5 mils dft. 46% solids; 138 g/L.
b. Finish: ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series. Two (2) coats at minimum 1.6 mil dft per coat. 39% volume solids; VOC 0 g/L.
   Optional Upgrade Finish: Pro Industrial High Performance Acrylic S/G, B66-650 Series, 2.5 - 4.0 mil dft, VOC <50 g/l

2. PPG
b. Finish: Speedhide Interior Semi-Gloss Enamel, 6-500 Series. Two (2) coats.

3. GLIDDEN PRO
a. Primer: DevFlex 4020 Direct to Metal Primer 4020PF.
b. Finish: Lifemaster No VOC Interior Latex Semi-Gloss Paint 9200 Series. Two (2) coats.

4. FARRELL-CALHOUN
a. Primer: Tuff Boy 100% Acrylic DTM Primer 5-56. One (1) coat at 1.8 mils dft. 39% volume solids; VOC 45 g/L.
b. Finish: Evergreen 100% Acrylic Interior Semi-Gloss Enamel 3300. Two (2) coats at 2.0 mils per coat. 38% volume solids; VOC <5 g/L.

5. Surfaces: Hollow metal doors, frames, door mullions, railings, galvanized metal surfaces.
I. Wood - Painted.
   1. SW
      a. Primer: Premium Wall & Wood Primer B28W8111 One (1) coat at minimum 1.8 mil dft. 46% solids; VOC <50 g/L.
      b. Finish: ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series. Two (2) coats at minimum 1.6 mil dft per coat. 38% volume solids; VOC 0 g/L.

   2. PPG
      a. Primer: Seal Grip Interior/Exterior 100% Acrylic Universal Primer/Sealer 17-921 Series. One (1) coat at minimum 1.5 mils dft. 37% to 41% solids; VOC 89 g/L.
      b. Finish: Speedhide Interior Enamel Latex Semi-Gloss. Two (2) coats at minimum 1.3 mil dft per coat. 35% to 39% volume solids; VOC <5 g/L.

   3. GLIDDEN PRO
      a. Primer: Lifemaster No VOC Interior Primer 9116-1200. One (1) coat.
      b. Finish: Lifemaster No VOC Interior Latex Semi-Gloss Paint 9200 Series. Two (2) coats.

   4. FARRELL-CALHOUN
      a. Primer: Waterborne 100% Acrylic Enamel Undercoater 699. One (1) coat at 1.6 mils dft. 34.5% volume solids; VOC 46 g/L.
      b. Finish: Evergreen 100% Acrylic Interior Semi-Gloss Enamel 3300. Two (2) coats at 2.0 mils per coat. 38% volume solids; VOC <5 g/L.

J. Wood – Satin Stained Finish: Alkyd based stain with alkyd based polyurethane satin varnish finish.
   1. Wood Filler: Paste wood filler (open grains only).
   2. Stain: Interior alkyd wiping stain; colors as indicated on the drawings. Final stain approval by Associate from approved samples.
      a. FARRELL-CALHOUN
         (1) Wood Kraft Waterborne Penetrating Wiping Stains 1500. 30% volume solids; VOC 125 g/L.
         (2) Wood Kraft Linseed Oil-Alkyd Wiping Stains 1110/1500 Line. 32.5% volume solids; VOC 519 g/L
      b. Sherwin-Williams
         (1) WoodClassics “250” Interior Oil Wood Stain, A49W8 75% solids, VOC <250 g/l
         (2) WoodClassics Interior Oil Wood Stain, A49 Series 34% solids, VOC 524 g/l

   4. Finish Coats: Two (2) coats satin polyurethane varnish at approximately 1.4 mils dft per coat.
      a. FARRELL-CALHOUN
         (1) Wood Kraft Interior Waterborne Acrylic-Polyurethane Satin Varnish 1192. Minimum of three (3) coats at 1.2 mils per coat dft. 27.5% volume solids; VOC 146 g/L.
         (2) Wood Kraft Satin Polyurethane Varnish 1122. Min.of two (2) coats at 1.8 mils dft. 46.7% volume solids; VOC 425 g/L
      b. Sherwin-Williams
(1) WoodClassics Waterborne Polyurethane Satin Varnish, A68V91 26% Solids, VOC 309 g/l
(2) WoodClassics Polyurthane Varnish, A67 Series, 36% Solids, VOC 488 g/l

K. Steel Stairs and Railings: Steel and Iron Finish
1. Surface Preparation: Clean surfaces of dirt, grease, loose rust, mill scale and other deleterious materials.
2. SW
   a. Prime Coat: Pro Industrial Procryl Primer B66-310. One coat at 2.4 mils dft.; VOC 110 g/L.
   b. Finish Coat (All steel exposed to view): Waterbased Acrolon 100 Water Based Urethane B65 Series. Two coats at minimum 2.0-4.0 mil dft per coat. VOC <100 g/L.

3. BENJAMIN MOORE
   a. Prime Coat: Waterborne Polyamide Epoxy Gray Primer Series M42. One (1) coat at 1.5 to 2.5 mils dft. 43% solids; VOC 136 g/L.
   b. Finish Coat (All Steel Exposed to View): Waterborne Urethane Semi-Gloss Finish Series M73S. Two (2) coats at 1.5 to 2.5 dft per coat. 38% solids; VOC 213 g/L.

4. GLIDDEN PRO

5. PPG
   b. Finish: Pithane Ultra Gloss Urethane Enamel 95-812 Series, 2 coats

6. Colors: As selected by Architect.

L. Cementitious Fireproofing
1. SW
   a. Finish: ProMar 200 Zero VOC Interior Latex Semi-Gloss B30-2600 Series. Two (2) coats at minimum 1.7 mil dft per coat. 39% volume solids; VOC 0 g/L.

2. PPG
   b. Finish: Pure Performance Interior Semi-Gloss Latex 9-500 Series. Two (2) coats at minimum 1.3 mil dft per coat. 35% to 39% volume solids; VOC 0 g/L.

3. GLIDDEN PRO
   a. Finish: Lifemaster No VOC Interior Latex Semi-Gloss Paint 9200 Series. Two (2) coats.

4. FARRELL-CALHOUN
   a. Finish: Evergreen 100% Acrylic Interior Semi-Gloss Enamel 3300. Two (2) coats at 2.0 mils per coat. 38% volume solids; VOC <5 g/L

M. Exposed Structure - Ferrous (Eg-Shel): Dryfall (Acrylic) Similar to MPI INT 5.1C.
1. SW
   a. Primer: ProCryl Universal Primer, B66-310 Series (2-4 mils dft)
b. Finish: Low VOC Waterborne Acrylic Dry Fall, B42W82 Two coats at minimum 4.5 mils dft.

2. PPG
b. Finish: Speedhide Interior Super Tech WB Acrylic Dry Fog Latex, 6-725 two coats at minimum 2.5 mil dft per coat.

3. GLIDDEN PRO
a. Primer: Devflex DTM Waterborne Acrylic Primer #4020PF; 1 coat.


N. Exposed Structure - Galvanized (Flat): Dryfall (Acrylic) Similar to MPI INT 5.3H.
1. SW
a. Finish: Low VOC Waterborne Acrylic Dry Fall, B42W82 Two coats at minimum 2.5 mils dft per coat.

2. PPG
a. Finish: Speedhide Interior Super Tech WB Acrylic Dry Fog Latex, 6-725 two coats at minimum 2.5 mil dft per coat.

3. GLIDDEN PRO
a. Finish: Waterborne Interior Flat Dry Fall #1280; 2 coats.

O. Gypsum Board Walls – Scrub Resistant Paint
1. Manufacturer/Product: SCUFFMASTER Scrubtough (MASTER COATING TECHNOLOGIES) or equal by TNEMEC or manufacturers listed in 2.01A complying with performance requirements.
2. Water based; eggshell.
3. Maximum VOC (EPA Test Method 27): Less than 150 g/L.
5. System
a. Primer: Scuffmaster Primemaster Primer/Sealer; 1 coat.
b. Finish: Scuffmaster Scrubtough Performance Paint with Microban; 2 coats; dft as required for complete coverage.

P. Gypsum Board Walls – Pearlescent Coating
1. SCUFFMASTER Smooth Pearl (MASTER COATING TECHNOLOGIES) or equal by TEX COTE, POLOMYX or manufacturers listed in 2.01A complying with performance requirements.
2. System consisting of base coat, pearlescent coat and clear coat.
3. Water based; smooth finish; satin.
4. Maximum VOC (EPA Test Method 27): Less than 150 g/L.
5. System
a. Primer: 1 coat acrylic high-solids. Type as recommended by finish coat manufacturer.
b. Base Coat: Scuffmaster Master-Coat 100; dft complete coverage
c. Pearlescent Coat: Scuffmaster Clear Pearl Coat; applied in 2-3 passes to match Architect approved sample.

2.06 COATINGS AND FINISH MATERIALS SCHEDULE
A. Metals – Steel and joist surfaces that will be concealed after erection, such as, the top flange or steel embedded in concrete and masonry.
   1. TNEMEC
      b. Finish: Series L69F Epoxoline II.
   2. CARBOLINE
      a. Primer: Carbozinc® 18 WB
      b. Finish: Carboguard 890
   3. GLIDDEN PRO
      c. Field Spot Primer: Devoe Coatings Devran 201H Universal Epoxy Primer.
   4. SHERWIN-WILLIAMS
      a. Shop Preparation and Shop Primer: See Section 05 12 00.
      b. Field Preparation: SSPC SP-11.
      c. Field Spot Primer: S-W does not have equal to primer listed
      d. Finish: DuraPlate 235 Epoxy, B67W235 @ 3.0 to 4.0 mils DFT.

B. Metals: Exposed structural framing and metal deck in areas.
   1. TNEMEC
      a. Finish: Series 115 Unibond DF @ 2.0 to 4.0 mils DFT.
   2. CARBOLINE
      a. Finish: Galoseal Finish @ 2.0 - 4.0 DFT
   3. GLIDDEN PRO
   4. SHERWIN-WILLIAMS
      a. Shop Preparation and Shop Primer: See Section 05 12 00 and
         05 30 00.
      b. Field Preparation: SSPC SP-11.
      c. Finish: S-W Spraylastic Exterior S/G Dryfall @ 2.0 to 4.0 mils
         DFT, B42W17, 43% Solids, VOC <100 g/l

C. Pavement / Traffic Marking Paint
   1. Type: Alkyd or latex.
   2. Color: White; unless indicated otherwise on drawings
   3. Sheen: Flat
   4. Percent Solids (by weight): 70% to 78%.
   5. Reference: (Alkyd) TT-P-115F Type 1; (Latex) TT-P-1952B Type 1
   6. Drying Items: Under normal field conditions, paint shall be dry to the touch, be free from pickup within 20 minutes, and completely dry within one hour.
   7. Bleeding: Paint shall not bleed or discolor when sprayed on bituminous surfaces.
   8. Manufacturer/Product: PORTER GUARD Alkyd Zone Marking Paint #PP1418 (white) / #PP1419 (yellow); PITTSBURGH PAINTS Traffic and Zone Marking #11-3 (white) #11-10 (yellow); SHERWIN WILLIAMS Setfast Acrylic Waterborne Traffic Marking Paint #TM226 (white) #TM225 (yellow) or equivalent by ICI PAINTS or WILSON PAINT COMPANY.

PART 3 EXECUTION
3.01 INSPECTION

A. Examine substrate surfaces and installation condition. Report condition(s) that might affect proper application.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Initial application of paint to a surface constitutes acceptance of existing conditions and responsibility for satisfactory performance.

D. Examine specification sections of other trades and their provisions regarding painting. Surfaces left unfinished shall be painted or finished as part of the work of this Section unless specifically noted otherwise.

3.02 SURFACE PREPARATION

A. General
1. Broom clean and remove excess dust before painting is started in any area
2. Broom cleaning not permitted after operations have begun in the area.
3. Surfaces shall be clean, dry and adequately protected from dampness.
4. Surfaces shall be free of any foreign materials that will adversely affect adhesion or appearance of applied coating.
5. Remove any mildew and neutralize the surface prior to applying coating.

B. Existing Surfaces Scheduled for Painting or Finishing
1. Condition, clean, sand, prime, seal and prepare existing surfaces for application of finish materials specified. Provide only finish coats over existing surfaces except where condition of existing surfaces or type of existing surface requires priming and sealing.
2. Remove loose, blistered, scaled, or crazed finish to bare base material.
3. At conditions where new work adjoins existing work, prepare existing surface extending to the nearest break in the plane of the surface.

C. Concrete Masonry and Concrete
1. Remove splatters, dust, dirt by brushing or water washing with clear water
2. Remove misplaced mortar.
3. Cracks, abrasions and other defects shall be cut out, patched flush, and sanded smooth and sealed before applying prime coat.
4. Existing Surfaces
   a. Surfaces with minor loose or blistered paint: Remove loose, flaking, blistered paint; clean as specified. Fill surface cracks with approved latex base filler; apply primer-sealer over substrate and filled cracks
   b. Multi-coated surfaces with major loose or blistered paint requiring complete paint removal: Remove paint down to bare substrate using chemicals, pressure methods, or other acceptable methods. Fill contraction and structural cracks with self-bonding filler or elastomeric sealant worked well into the cracks to prevent leaks, then wipe excess materials from the surface. Apply a latex base or other acceptable prime and fill material to fill all defects and holes, wipe excess material off surface; let filler material dry for 24 hours minimum before applying primer.
D. Wood - Painted
1. Prime and backprime interior finish wood products, before their installation, with interior wood prime paint.
2. Sandpaper to smooth and even surface, dust off.
3. Countersink nails.
4. Remove resin with scrapers, sandpaper, mineral spirits or turpentine.
5. Apply shellac or knot sealer to all knots, pitch and resinous sapwood, allow to dry thoroughly prior to priming.
6. After priming, putty all nail holes, cracks, open joints and other defects, sand smooth and dust off. Color putty to match primer; if putty is not compatible with finish, spot prime puttied areas.

E. Wood - Stained
1. Prime and backprime faces, edges and end with first coat before installation.
2. Sandpaper to smooth and even surface, dust off.
3. Countersink nails.
4. Putty all nail holes, cracks, open joints and other defects with mixture of stain and putty so that appearance of completed work is uniform. Sand smooth and dust off.

F. Structural Steel and Miscellaneous Ferrous Metal
1. Bare Metal Surfaces
   a. Remove grease, oil, dirt and other foreign material prior to prime coat application as needed according to SP-1, SP-2 and/or SP-3
   b. Remove rust prior to prime coat application according to SP-11.
   c. Include all hangers and miscellaneous fabricated items.
2. Shop Primed Surfaces
   a. Fill open joints or abrasions in shop prime coat with filler; feather edges, sand smooth, and touch-up with primer compatible with shop primer. Extend primer beyond treated area.
   b. Remove grease, oil, dirt and other foreign material prior to prime coat touch-up where necessary per SP-1, SP-2 and/or SP-3.
   c. Include all hangers and miscellaneous fabricated items.

G. Galvanized or Zinc-Coated Items
1. Pretreat surfaces prior to application of prime coat with phosphate pretreatment, unless prime coat material to be used is recommended by its manufacturer for direct application over zinc treated surfaces of the type at hand. Follow manufacturer's directions.
2. Remove dirt or grease on surfaces scheduled for paint finish according to SP-1. Wipe dry with clean cloths.
3. Roughen surface with steel wool as necessary to remove gloss.

H. Gypsum Board
1. Fill minor irregularities with spackling paste.
2. Sand to smooth level surface and dust off.
3. Avoid raising nap of paper.

I. Plaster: Allow to cure a minimum of 2 weeks before finishing. Provide sonic moisture meter test results to confirm that plaster is dry and ready for paint.
J. Factory Primed Items: Verify compatibility between factory applied primer and finish painting system. If compatibility cannot be guaranteed, then provide barrier coat compatible with both finishes.

K. Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants. If aluminum does not come from the manufacturer with an approved paint grip finish, consult the coating manufacturer for the appropriate surface preparation requirements. Minimum requirement to meet SSPC SP 16.

3.03 APPLICATION

A. General
1. Apply all paint in strict accordance with the manufacturer's instructions. Data sheets take precedence over these specifications if more restrictive, except for the minimum DFT specified in the schedule.
2. Do not apply until preceding coat is dry to manufacturer's recommendations.
3. Do not apply to any surface unless it is thoroughly dry.
4. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes if moisture content of surface is greater than recommended by manufacturer.
5. Do not use material that has exceeded the pot life stated by the MFR.
6. Apply to the following workmanship requirements:
   b. Absence of ridges, sags, runs, drops, laps, unnecessary brush marks, holidays, air bubbles and excessive roller stipple.
   c. Thorough mixing of paint and limited use of thinners.
   d. Uniformity of film thickness.
   e. Proper drying time between coats.
   f. Protection of unpainted and finished surfaces.
7. Coverage and hide shall be complete. When color or undercoats show through final coat, recoat until the paint film is of uniform finish, color, appearance, and coverage, at no additional cost to Owner.
8. Edges of paint or finish adjoining other materials or colors shall be sharp and clean without overlapping.

B. Methods
1. Application may be by roller, brush, spray or other approved means.
2. When utilizing spraying, be careful not to use methods which will affect other trades work in adjacent areas.

C. Mixing
1. Mechanically mix before use.
2. Agitate during application as required.
3. Do not tint or shade in field unless permitted by Architect.

D. Thinning
1. Dilute only as required to achieve suitable application viscosity.
2. Use only type and amount recommended by manufacturer.
E. Approvals: Do not apply succeeding coat of paint until previous coat has been inspected and written approval is given.

F. Electrical Conduits
1. Do not paint any electrical conduit or boxes unless they are exposed and abutting a surface that is to be painted or stained.
2. Conduits and boxes to be painted shall be given a coat of galvanizing pretreatment followed by the paint system for the adjoining surface.

G. Protection of Surfaces
1. Provide covers, drop cloths and masking to protect unpainted surfaces previously finish painted. Use special care in protecting electrical and mechanical items which may be damaged by the painting operations (i.e., overspray and solvents that might damage the internals of the item).
2. If possible, remove items not to be painted such as hardware, accessories, electrical plates, lighting fixtures and/or trim, mechanical grilles and louvers and similar items in contact with painted surfaces.
3. Use caution when painting exterior work to avoid wind carrying overspray, drippings, etc., onto adjacent structures, facilities and vehicles.
4. Following completion of painting, reinstall removed items by workmen skilled in the trade involved and remove all covers, masking and drop cloths.

H. Fire and Smoke Partitions
1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 2 1/2 inches high.
2. Stenciled message: "SMOKE PARTITION" or, "X HOUR FIRE PARTITION" as applicable.
3. Locate not more than 20 feet on center on corridor sides of partitions, and with a least one message per room on room side of partition.
4. Use semi-gloss paint of color that contrasts with color of substrate.
5. Locate approximately 12" above ceiling tile.

END OF SECTION
SECTION 10 11 00
VISUAL DISPLAY SURFACES

PART 1 GENERAL

1.01 WORK INCLUDED
A. Provide the following items, as specified herein and indicated on the drawings:
1. Chalkboards
2. Tackboards
3. Markerboards
4. Glass markerboards, magnetic
5. Conference units
6. Tackable wallboard
7. Pegboard
8. Map rails
9. Accessories
   a. Flag holders
   b. Marker trays

1.02 RELATED SECTIONS
B. Wood Blocking: Section 06 10 00.

1.03 REFERENCES
A. ASTM International
   1. ASTM C1036 Specification for Flat Glass
   2. ASTM C1048 Specification for Heat-Treated Flat Glass-Kind HS Coated and Uncoated Glass
B. ANSI - American National Standards Institute
   1. ANSI Z-97.1 Safety Performance Specifications and Methods of Test Used in Buildings

1.04 SUBMITTALS
A. Samples: Submit samples of color finishes for all items specified for selection by Architect.
   1. Submit 6" length sample of trim required.
B. Shop Drawings: Submit drawings showing sizes, arrangements, accessories and installation details of all items specified.
C. Submit manufacturer’s product data showing reference numbers, construction details and methods of assembly.
D. Guarantee
1. Chalkboard: Provide written guarantee to the Owner signed by an officer of the manufacturer of the chalkboard stating that all chalkboards which do not retain their original writing quality, original erasing quality and original visual acuity for 20 years after date of acceptance will be replaced without charge to the Owner.

2. Markerboard: Provide written guarantee to the Owner signed by an officer of the manufacturer of the marker board stating that all marker boards which do not retain their original writing quality, original erasing quality and original visual acuity for 5 years after date of acceptance will be replaced without charge to the Owner.

E. Cleaning Instructions: Provide written instructions for any care, maintenance and cleaning required beyond normal custodial care.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original unopened shipping cartons. Store indoors in clean, dry area in manner to prevent warping or physical damage.

B. Protect work from dust, dirt and physical damage during and after installation until final acceptance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. POLYVISION; CLAIRIDGE PRODUCTS AND EQUIPMENT; ADP LEMCO; PLATINUM VISUAL SYSTEMS; GHENT MANUFACTURING, DRAPER.

2.02 TACKBOARD

A. Description: 1/4" flame retardant cork laminated to 1/4" hardboard with extruded aluminum trim, clear anodized finish.
   1. Provide 2 map hooks per 4' of tackboard.
   2. Color: As selected by Architect from manufacturer's standard colors.

B. Sizes: As indicated on drawings.

C. Provide all required mounting devices for installation without exposed fasteners.

2.03 CHALKBOARD

A. Description: 24 gage enameling steel coated with 2 layers of porcelain enamel, with a core of 7/16" particleboard and .005" aluminum backer sheet.

B. Color: As selected by Architect from manufacturer's standard colors.

C. Trim: Extruded aluminum perimeter trim approximately 5/8" wide; eraser/chalk trough with end closures (approximately 3-1/4" from face of wall); map rail with cork insert (approximately 1" wide).
1. Finish: Clear anodized.
2. Provide 2 map hooks per 4’ of chalkboard.

D. Sizes: As indicated on drawings.
E. Provide all required mounting devices for installation without exposed fasteners.

2.04 MARKERBOARD

A. Description: Steel sheets with nickel cobalt primer coat of .002" min. thickness and surface coat of high fired type porcelain frits of .0025" min. thickness; laminated to 3/8” particleboard core and aluminum foil panel backing.
B. Color: White.
C. Trim: Extruded aluminum perimeter trim approximately 5/8” wide; marker trough with end closures (approximately 3-1/4” from face of wall); map rail with cork insert (approximately 1” wide).
   1. Finish: Clear anodized.
   2. Provide 2 map hooks per 4’ of chalkboard.
D. Provide all required mounting devices for installation without exposed fasteners.
E. Sizes: As indicated on drawings.

2.05 MAGNETIC GLASS MARKERBOARD

A. Manufacturers
   1. Basis of Design: Drawings and specifications are based on GLASPRO.
   2. Other Manufacturers: Glass boards manufactured by HIGHTOWER GROUP, FORMS + SURFACES or CLARUS GLASSBOARDS are acceptable provided they meet the Basis of Design requirements and the design intent indicated.
B. Materials
   1. Description: Single sided magnetic; polished edges, holes and cutouts.
   2. Sizes: As indicated on drawings.
   4. Thickness: 5/16”.
   5. Provide all required mounting devices and trim for installation without exposed fasteners. Provide one marker tray for each board.

2.06 CONFERENCE UNIT (MARKER BOARD/PROJECTION SCREEN WITH CASE)

A. Description: Wall-mounted two-door conference unit consisting of two-door cabinet with perimeter frame, sides and back, with interior writing surface and tackboard panels and pull down projection screen.
   1. Provide unit completely assembled.
   2. Provide concealed hangers.
B. Manufacturer
   2. Other Acceptable Manufacturers: Those listed in Paragraph 2.01A herein.

C. Colors: As selected by Architect from manufacturer's standards.

D. Size: 48 inch x 48 inch (with doors closed).

2.07 PEGBOARD
A. Description: 1/4" hardboard with 9/32" diameter holes on 1" centers with extruded aluminum trim, clear anodized finish. Color of hardboard to be selected by Architect from manufacturer's standard colors.

B. Sizes: As indicated on drawings.

C. Provide all required mounting devices for installation.

2.08 TACKABLE WALLBOARD
A. Provide vinyl faced fiberboard tackboard in areas indicated. Conform to the following:
   1. Description: ½" thick 7 pcf fiberboard with Type I vinyl facing. Colors as selected by Architect.
   2. Manufacturer: POLYVISION or manufacturers listed under Article 2.01.
   3. Limits: Extend from floor to ceiling.
   4. Joints: Butt type; wrap facing around joints; similar to POLYVISION Type C-2.
   5. Mounting: Adhesive mount to substrate; use methods and material as recommended by manufacturer.

2.09 MAP RAIL
A. Extruded aluminum frame with cork inserts.

B. Size: 6'-0" long by 2" high.

C. Manufacturer/Model: DRAPER Model MR-206 with end plates and two combination hook/clips per rail or equal by manufacturers listed in Article 2.01 herein.

2.10 ACCESSORIES
A. Provide the following accessories for each individual markerboard unit:
   1. 1 flag holder (one per room).

2.11 FABRICATION
A. Fabricate and factory assemble complete units where possible. Frames shall be straight and square with joints tight and neat.
PART 3 EXECUTION

3.01 INSPECTION

A. Verify building items affecting this section are placed and ready to receive work.

B. Field measurements shall be taken to verify that boards will fit in their designated locations.

C. Install wood grounds or wood blocking as required.

3.02 INSTALLATION

A. Workmanship
   1. Install boards straight and level and securely anchored in place.
   2. Leave surfaces clean and free from defects at time of final acceptance.

B. Clean-up: Remove all cartons, debris, scraps, etc. and leave spaces clean and have boards ready for use.

END OF SECTION
SECTION 10 14 10

INTERIOR SIGNAGE

PART 1 GENERAL

1.01 WORK INCLUDED
A. Work includes:
   1. Room numbers.
   2. Room identification.
   3. Restrooms
      a. Wheel Chair Accessible
      b. Non-Accessible
   4. Stairwell identification.
   5. Floor identification (stairwell).
   6. Directional/Informational signs.
   7. Elevator door jamb plate (floor numbering).
   9. Posted occupancy limit.
10. International telephone symbol.
   11. Elevator fire emergency plaque.
   12. Tactile (ADA) exit signs

B. All signs which identify permanent facilities/accommodations shall be tactile and braille and limited minimally to room numbers, restrooms, stairways, floor identification, elevators and room names as deemed appropriate by the Owner.

1.02 SUBMITTALS
A. Shop Drawings: Submit manufacturer's product data, where applicable, and complete drawings showing all identifying devices and installation details in accordance with the requirements of the General Conditions.

B. Samples: Submit samples for materials, finishes, colors, letter styles, etc., as required for selection and approval by Architect prior to fabrication of identifying devices.

C. Final signage schedule must be approved by Owner prior to fabrication. Submittal to Owner should be made through the Architect.

1.03 QUALITY ASSURANCE
A. Signage Standards: Conform to the Americans with Disabilities Act (ADA) Standards where applicable and to the extent as indicated.

B. Acceptable Manufacturers: All units are to be custom fabricated; manufacturer's products meeting the specifications will be acceptable. Manufacturers must be regularly engaged in fabrication and installation of signage units and related identifying devices.
1. Fabricator shall make at least one visit to the site before production begins to review all sign locations and installation conditions with Architect and Owner's representative.
2. Fabricator must review all dimensional changes with Architect.

C. Approvals: All identifying devices shall be approved at the fabricator's shop by the Architect prior to shipment and installation.

D. Spelling and Braille Accuracy: Responsibility of sign manufacturer.

E. The Owner has the right to renumber the room numbers during construction. Manufacturer must not begin fabrication of room number plates until room numbers have been approved by the Owner, in writing, through the Architect.

F. Room identifications will be provided to the Contractor by the Owner during construction.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original shipping cartons with seals unbroken.

B. Protect materials from physical damage.

C. Store materials in clean, dry area.

D. Inspect all materials prior to installation to assure proper function and condition of all items.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Locations, Quantities, Graphics and Copy: As indicated on drawings and/or specified (scheduled) herein.

2.02 MATERIALS

A. Plates: High pressure phenolic "ES" plastic; scratch resistant, non-static, thermoset, rated self-extinguishing.
   1. Colors: As selected by Architect.
   2. Thickness: 3/32" for ADA plates; 1/16" for non-raised copy (flat) plates.

B. Changeable Copy: Provide 3/32" thick plastic back-up plate laminated to back of face plate to create slot for removable nameplates.

C. Provide an integral method to create tactile and Braille signs; producing a unitary component. Glued on or laminated letters or Braille cells are not acceptable.

2.03 DESIGN GUIDELINES
A. Plate Shape: Square cornered; do not bevel edges.

B. Letter Style
1. ADA Signs: Helvetica medium, all capital letters.
2. All Other Signs: Helvetica medium, mixed upper and lower case.

C. Tactile Letters and Braille: Grade II braille; raised 1/32” above background surface. Provide Braille dome topped same color as background. Sign manufacturer shall be responsible for verifying accuracy of spelling, both tactile and Braille.

D. Letter Size
1. Tactile Signs: Minimum letter size is 5/8” for capital letters. Room numbers to be 1”.
2. Non-tactile Signs: Between 3/8” and 1” capital letter height. Larger letters are permitted on directional signs or on signs where reading distance is greater than 15'-0”.

2.04 METHOD OF MANUFACTURING
A. Tactile Signs: Relief engraved plates.
B. Non-Tactile Signs: Routed engraved.

2.05 SIGNS REQUIRED FOR TACTILE/BRAILLE
A. Room Numbers: 2-1/4” x 6-3/4” plate with 1” numerals centered horizontally on plate with Braille directly below numerals.

B. Room Identification: This sign is in addition to Room Number specified in 2.05A.
   1. Size determined by copy requirements, laid out flush left with 3/4” margin on left, room name in 5/8” caps with Braille directly below type copy, all flush left.

C. Restrooms - Wheel Chair Accessible: Approximately 6” wide x 8” high plate with 1” capital letters (MEN or WOMEN), centered on the plate with Braille centered directly below the word. Provide a routed engraved wheel chair access symbol and a universal man or woman symbol located above the word. No border.

D. Restrooms - Non-Accessible: Two plates required.
   1. 6-3/4” wide by 3-3/4” high plate with 1” room number centered horizontally on plate with Braille centered directly below numerals. "Men" and "Women" will appear in 3/4 inch capital letters, centered horizontally on the plate with Braille centered directly below the word.
   2. 6-3/4” x 6-3/4” plate with 5/8” raised caps informing location of nearest accessible restroom. Same message in Braille centered below copy.

E. Stairwell Identification: 2-1/4” x 8-1/4” plate with 3/4” capital letters centered on plate. Braille centered directly below the type copy.
F. Floor Identification - Inside Stairwells: 2-1/4" x 8-1/4" plate with 3/4" capital letters (1st FLOOR, 2nd FLOOR, etc.) centered on plate. Braille centered directly below the type copy.

G. Directional/Informational Signs: Wall mounted; non-tactile; in upper and lower case. Letter height shall be at least 1" cap height for directional signs. Letter sizes for informational signs may be less than 1".

H. Elevator Door Jamb Plate: 3-3/4" x 3-3/4" plate with 2" numerals centered horizontally on plate with Braille centered directly below numerals.

I. Tactile (ADA) Exit Signs: Approximately 5" x 3" plate with minimum 3/4" high capital letters centered on plate. Braille centered directly below the type copy.

2.06 SIGNS REQUIRED FOR NON-TACTILE/BRAILLE SIGNAGE

A. Plate Shape: Square cornered; do not bevel edges.

B. Plate Heights
1. 2-1/4" for one line of copy.
2. 3-3/4" for two lines of copy.
3. 5-1/4" for three lines of copy.

C. Changeable Copy Plates
1. Height: Same as in "B" above.
2. Length: 7-1/2"
3. Face openings of slot: 1" high with 3/4" margin at ends and bottom.
4. Allow 1/2" vertically between slot openings.
5. Slots behind openings: Allow for 1-1/4" wide x 1/16" thick blank changeable copy strips supplied by the Contractor for future engraving by Owner.
6. Tactile room numbers with Braille may appear on the face of the sign frame.

2.07 EMERGENCY ESCAPE DIRECTORY

A. Description: 18" x 12". Extruded aluminum "F" frame with anodized medium bronze finish and non-glare acrylic face. Provide with rigid masonite backing.

B. Copy: Color screen printed removable graphic of floor plan showing escape route from installed location. Locate at elevators and stair doors at each floor, and at building main entrance.

2.08 POSTED OCCUPANCY LIMIT

A. Posted Occupancy Limit: Provide sign reading, "Maximum Occupants Permitted This Space". Provide signage in accordance with IBC 1004 "Posting of Occupant Load". Locate signs in the following rooms:

List spaces here
2.09 INTERNATIONAL TELEPHONE SYMBOL

A. Description: 8" high x 6' wide, colors to match room signs. Text to read, "telephone" in 1" letters with Braille centered below. Graphics to include international wheelchair and telephone symbols.

2.10 ELEVATOR FIRE EMERGENCY PLAQUE

A. Description: Approximately 12" x 12". Text to read, "in case of fire use stairs" in 1" letters with Braille centered below. Graphics to include international wheelchair and stair symbols.

2.11 COPY POSITION

A. Lines of copy laid out flush left with a margin of 3/4" along the left edge of plate. Exceptions are small room numbers, restrooms and stairways shall be centered on the plate.

B. Left hand, right hand and bottom margins are 3/4". Vertical spacing measured between lower case letters is 3/4". Overall width and height of a plate is achieved with multiples of 3/4".

C. Locate directional arrows in upper left hand corner of plate. Arrows count as one line of copy.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount signs plumb and level.

B. Mount all identification devices with 3/4" foam tape on all four edges.

C. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.02 SIGNAGE SCHEDULE

A. Provide the following Sign Plates

1. Room Identification Signs: For bidding purposes, provide 9 room identification signs. Each sign will contain 20 symbols/characters arranged in two lines.

2. Women, combined with room number and handicap symbol and international symbol, as applicable, at each restroom.

3. Men, combined with room number and handicap symbol and international symbol, as applicable, at each restroom.

B. Provide room numbers at all door locations.
C. Stairwell Identification: Provide at all stair doors.

D. Floor Identification: Provide inside stairwell at all stair doors.

C. **International Telephone Symbol:** Provide at each public telephone.

D. Elevator Fire Emergency Plaque: Provide at each elevator stop.

F. Elevator Door Jamb Plates: Two plates required per elevator door, one on each side of the jamb.


F. Directional/Informational Signs: For bidding purposes, provide one per stair door on each floor and an additional one per lobby and vestibules on the entry floor. Each sign will contain 25 symbols/characters arranged in two lines. Locate as directed by Architect.

G. Posted Occupancy Limit: As specified hereinbefore.

H. Tactile (ADA) Exit Signs
  (List or indicated on drawings)

I. Sign Locations
   1. Single Doors: Locate signs on the wall next to the latch side of the door, 1" from the outside edge of the door frame and with the top edge of the uppermost sign 61-1/2" A.F.F.
   2. Pairs of Doors: Locate signs as specified above for single doors, except Architect will direct in field if sign occurs on right or left jamb of opening.

3.03 **CLEAN UP**

A. After completion of work remove all debris and tools from the premises, clean all adhesive spatter and run-over from finished surfaces and wash all plated clean of fingermarks and soil. Polish sign surfaces with a soft cotton rag.

**END OF SECTION**
SECTION 10 14 19
DIMENSIONAL LETTER SIGNAGE

PART 1   GENERAL

1.01  DESCRIPTION
A. Provide wall mounted building identification letters.

1.02  SUBMITTALS
A. Layout Drawings: Provide full size layout drawing indicating letter style, size and spacing.
B. Product Data: Submit for each cast dimensional character specified, including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options, and finishes.

1.03  PRODUCT DELIVERY, STORAGE AND HANDLING
A. Deliver in manufacturer's original unopened protective covering.
B. Store in original packing.
C. Handle so as to prevent damage.

PART 2   PRODUCTS

2.01  MATERIALS
A. Material: Cast aluminum; alloy and temper as recommended by sign manufacturer for the casting process used and for the use and finish indicated.
B. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.
C. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Furnish inserts, as required, to be set into masonry work.

2.02  DIMENSIONAL LETTERS
A. Cast Letters: Form individual letters by casting. Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Cast lugs into the back of characters and tap to receive threaded mounting studs. Comply with requirements specified for finish, style and size.
B. Text: As indicated.
C. Letter Style: Helvetica; all uppercase.
D. Size: 12" high.
E. Thickness: 1".

2.03 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.04 FINISH

A. General: Comply with NAAMA "Metal Finishes Manual" for finish designations and applications recommendations.

B. All exposed aluminum surfaces: [Architectural Class II, clear anodized fine satin finish] [Fine satin directional textured aluminum finish with two coats of clear lacquer] [Architectural Class II, medium bronze anodized finish] [Baked-enamel finish; color as selected by Architect].

2.05 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, letters manufactured by A.R.K. RAMOS, ANDCO INDUSTRIES CORP., ASI SIGN SYSTEMS or VOMAR PRODUCTS, INC. are acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
3.02 INSTALLATION

A. Securely install in location indicated on the drawings in accordance with manufacturer’s written instructions and recommendations.

1. Install letters level, plumb, true to line and at heights and locations indicated, with surfaces free from distortion or other defects in appearance.
2. Mount letters with 1” projection from wall surface.

3.03 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION
SECTION 10 21 14
PHENOLIC TOILET COMPARTMENTS

PART 1  GENERAL

1.01  WORK INCLUDED
A. Provide phenolic toilet partitions and urinal screens with related components and accessories for complete installations.

1.02  RELATED SECTIONS
A. Sustainable Design Requirements: Section 01 81 13.
B. Toilet Accessories: Section 10 28 13.

1.03  SUBMITTALS
A. Shop Drawings: Include the following:
   1. Manufacturers product data.
   2. Plans, elevations, details of construction, sizes of openings, anchoring devices, leveling details, hardware fittings, and fastenings.
B. Color Selector: Complete range of manufacturer's colors.
C. Special Environmental Requirements: Submit the following in accordance with Section 01 81 13):
   1. Recycled Content:
      a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
      b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
      c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
      d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.
   2. Local/Regional Materials:
      a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
      b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
      c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
      d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location
information for each component. Indicate the percentage by weight of each component per unit of product.

1.04 QUALITY ASSURANCE

A. Take field measurements prior to fabrication to assure proper fitting.

B. Provide setting drawings, templates, instructions and directions for installation of anchorage devices.

C. Installer Qualifications: Minimum five (5) years continuous experience installing toilet compartments on projects of equivalent size, quantity and complexity.

D. Regulatory Requirements: Conform to ANSI A117.1 code for access for the handicapped operation of toilet compartment door and hardware.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver items in manufacturer's original unopened protective packaging. Store materials in original packaging to prevent soiling, physical damage or wetting.

B. Handle so as to prevent damage to finish surfaces.

PART 2 PRODUCTS

2.01 DESCRIPTION

A. General: Material and products to be manufactured regionally AND harvested, extracted, or recovered regionally within a radius of 500 miles from the project site.

B. Type: [Floor mounted, overhead braced] [Ceiling hung] type, standard height, width as required to fit between walls or as indicated.

C. Materials: Provide manufacturer's standard doors, pilasters and panels fabricated specifically for the partition system.

1. Doors, Pilasters and Panels
   a. Cores: Solid phenolic. All edges shall be polished black.
   b. Face Finish
      1) High pressure, matte finish, melamine surface fused to core.
      2) Colors: As selected by Architect. As many as 4 colors may be selected on the project.

2. Recycled Content: Minimum 20 percent post-consumer recycled content.

D. Components
   1. Doors, Pilasters and Panels
      a. Stiles: ¾” thick.
      b. Panels: ½” thick.
      c. Doors: ¾” thick
      d. Fire Classification: ASTM E84, Class II.
1) Flame Spread: 70.
2) Smoke Density: Under 100.

choose

2. Hinges: Continuous piano hinge, full height of door, minimum 16 gage, 2" wide, 1/8" diameter aluminum pin.

2. Hinges: Gravity type, adjustable to hold door open at any angle up to 90 degrees. 3 hinges per door.

3. Headrail: Aluminum extrusions, anodized with anti-grip configuration; fastened to the pilaster tops.

4. Latch: Minimum 14 gage. Recessed latch unit. Latch units shall have emergency access capability.
   a. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

5. Keeper: Minimum 11 gage. Covers top and bottom of latch when door is in closed/locked position.

6. Stops: Minimum 11 gage. 2 required per door.

7. Brackets: U-shaped channels, aluminum, anodized and polished with 3 brackets per connection

8. Shoes: Nominal 4" high, one piece, stainless steel shoe to conceal leveling device on stiles. #4 finish.

8. Ceiling Trim: One piece, stainless steel cover to conceal leveling device on stiles. #4 finish.

9. Coat Hook and Bumper: Manufacturer's standard unit, rubber tipped for in-swinging doors.

10. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors

11. Coat Hook: Manufacturer's standard at out-swinging doors.


E. Urinal Screen: Provide wall mounted type consisting of ¾” thick screen panel and required fittings and hardware.

2.02 FABRICATION

A. Reinforcement
1. Provide threaded steel inserts and reinforcement for installation of hardware, fittings, brackets and accessories specified elsewhere.

2. Where grab bars attach to toilet partitions, reinforce as required to support 300 pounds, minimum.

B. Panels, Doors, Posts and Stiles
1. Provide leveling devices at floor, bolted to panels and concealed with removable shoes as specified below.

2. Ease edges for smooth surface, free of sharp corners.

3. Panels and doors to be approximately 58" high; provide bottom 12" above floor.

4. Door Dimensions: Unless otherwise indicated, furnish 24" wide in-swing doors for ordinary toilet compartments and minimum 32" wide (clear opening) out-swing doors for compartments that meet the requirements of the Americans with Disabilities Act (ADA).
2.03 MANUFACTURER

A. Subject to compliance with specified requirements, provide partitions by one of the following:
   1. ACCURATE PARTITIONS CORPORATION.
   2. AMPCO, INC.
   3. BOBRICK
   4. BRADLEY CORPORATION
   5. GENERAL PARTITIONS MFG. CORP.
   6. GLOBAL STEEL PRODUCTS CORP.
   7. KNICKERBOCKER PARTITION CORPORATION.
   8. METPAR CORP.
   9. SPEC-RITE

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's specifications.
   1. Field verify dimensions.
   2. Securely fasten in place, neat, level and plumb.
   3. Evidence of drilling, cutting and fitting to room finish shall be concealed in finished work.
   4. Adjust doors to swing freely and to remain open approximately 6" when unlatched.
   5. Set units with not more than 1/2" between pilasters and panels, and not more than 1" between panels or doors and walls.
   6. Adjust bottoms of doors level when doors are in closed position.
   7. Clean exposed surfaces and touch-up minor finish imperfections using materials and methods recommended by partition manufacturer and as acceptable to Architect.

END OF SECTION
SECTION 10 22 26
FOLDING PANEL PARTITIONS

PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide sound insulated, manually operated, folding, flat panel operable walls as indicated, complete including required fasteners, fittings and accessories.

1.02  RELATED SECTIONS

A. Sustainable Design Requirements:  Section 01 81 13.

B. Miscellaneous Metals (overhead framing):  Section 05 50 00.

1.03  QUALITY ASSURANCE

A. Manufacturer's Qualifications:  The Manufacturer shall have successful experience in the fabrication and installation of sound rated operable partition assemblies, including no less than 5 years’ experience in the fabrication and installation of assemblies equal to the size and complexity of this work.  Upon request, the manufacturer shall provide references and acoustical test reports for three similar recently completed projects.

B. Installer qualifications:  Sound rated operable partition assemblies must be installed by manufacturer, manufacturer's authorized distributor or an installer qualified in the installation and maintenance of specified equipment as approved by manufacturer.

C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.

1.04  SUBMITTALS

A. Product Data:  Submit Manufacturer's specifications and other data needed to prove compliance with all specified requirements.  Product data to include:  material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable panel partition, component, and accessory specified.  Include data on acoustical performance, surface-burning characteristics, and durability.

B. Installation Instructions:  Submit Manufacturer’s recommended installation instructions and procedures.

C. Shop Drawings:  Show location and extent of operable panel partitions.  Include plans, elevations, sections, details, attachments to other construction and
accessories. Indicate dimensions; weights; conditions at openings and for storage; and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, and direction of travel. Show blocking to be provided by others.

D. Product Certificates: Submit letter signed by manufacturer certifying that operable walls to be furnished on this project comply with the requirements of the specification.

E. Operation and Maintenance Data: For the following to include in maintenance manuals specified in Section 01 78 21:
   1. Panel finishes and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
   2. Seals, hardware, track, carriers, and other operating components.

F. Acoustical Laboratory Test Reports: Submit Manufacturer’s STC values for each of the specified operable partitions. Sound transmission loss and STC values shall be based on measurements conducted by a laboratory accredited for specific acoustical testing under the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90.

1.05 ACOUSTICAL PERFORMANCE REQUIREMENTS

A. Provide operable partition assemblies (including pass doors, seals, etc) that provide a minimum Sound Transmission Class (STC) of 50 and Noise Isolation Class (NIC) of 42. Sound transmission loss and STC values shall be based on laboratory acoustical testing, which is performed by a National Voluntary Laboratory Accreditation Program (NVLAP) approved testing laboratory. Testing shall be performed in accordance with ASTM E90. NIC values shall be based on field acoustical testing performed by a qualified acoustical consultant who has a minimum of 5-years’ experience in sound isolation measurements. [Field testing shall be performed in accordance with ASTM E336 and ASTM E413.]

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect products during transit, storage and handling to prevent damage, soiling and deterioration. Comply with the requirements of the manufacturer’s instructions for storage and handling.

B. Deliver materials in order as required by schedule for installation.

C. Handle materials in accordance with manufacturer's instructions.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify operable panel partition openings and storage arrangements by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
1.08 WARRANTY

A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.

B. Partition Warranty period: Two (2) years.

C. Suspension System Warranty: Five (5) years.

PART 2 PRODUCTS

2.01 FOLDING PARTITIONS

A. Manufacturer: Drawings and specifications are based on MODERNFOLD Acoustic-Seal [933] [932] [931]. Subject to compliance with the specified requirements, products by EMCO; HUFCOR; KWIK-WALL, PANELFOLD and MODERCO INC. are acceptable.

B. Operation: Consists of a series of continuously hinged [two panel hinged pair groupings] [individual], manually operated, flat steel panels, top supported with operable floor seals.
   1. Final closure accomplished by expanding jamb from panel edge or hinged panel as required by each door condition (i.e. partitions with pocket doors require expanding jamb).

C. Panel Construction
   1. Size: 3 inches thick in manufacturer’s standard widths.
   3. Panel Skins: 0.50-inch NAUF medium density fiberboard, single material or composite layers continuously bonded to panel frame.
   4. Core (Frame): 16 gage steel.
   5. Top Channel Assembly: Reinforced to support suspension components.
   6. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.

D. Panel Finish: Factory applied, Class 1 rated material, as per IBC with flame spread 0-25 as determined by ASTM E84.
   2. Acoustical, non-woven needle-punch carpet with fused fibers to prevent unraveling or fray of material. Color and pattern as selected by Architect.

D. Panel Finish - Marker Board: Factory applied, Class 1 rated material, as per OBC with flame spread 0-25 as determined by ASTM E84.
   1. Description: Steel sheets with nickel cobalt primer coat of .002” min. thickness and surface coat of high fired type porcelain frit of .0025” min. thickness.
   2. Colors: As selected by Architect from manufacturer’s standard colors.
   3. Provide all required mounting adhesives for installation without exposed edges.
E. Sound Seals
2. Horizontal Top Seals: Continuous contact extruded vinyl.
3. Bottom Seals: Automatic operable seals providing nominal 2-inch operating clearance with an operating range of +0.50-inch to -1.50-inch which automatically drop as panels are positioned, without the need for tools or cranks.

F. Suspension System: Continuous "C" channel shape steel track, supported by adjustable steel brackets connected to structural supports with threaded rods.
1. Panels supported by ball-bearing, steel wheel trolley assemblies.

2.02 POCKET DOOR

A. Manufacturer: Drawings and specifications are based on MODERNFOLD Stowaway Type II. Equal products by other acceptable manufacturers listed in 2.01A are acceptable providing they meet or exceed the requirements specified herein.

B. Door Construction
1. Size: Nominal 2.75 inches thick in equal widths to close opening.
2. Panel Skins: Class A Flame Spread Rated moisture resistant gypsum board.
3. Core (Frame): Extruded aluminum.
4. Top Channel Assembly: Reinforced to support suspension components.
5. Sound Seals: Gasketed astragal seals in vertical edges and jambs; fixed sweeps on horizontal edges.
6. Weight: Approximately 8 pounds per square foot (average hanging).
7. Hinges: Type and quantity as recommended by manufacturer for door height and weight.
   a. Finish: US26D.
8. Provide manufacturers standard latching type hardware.

2.03 PASS DOORS

A. Pass Doors: Swinging door built into and matching panel materials, construction, acoustical qualities, fire rating, finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.
2. Single Pass Door: 36 by 80 inches.
3. Pass-Door Hardware: Equip pass door with the following:
   a. Door Seals: Mechanically operated floor seal on panels containing pass doors.
   b. Exit device hardware.
c. Concealed door closer.
d. Exit Sign: Recessed, self-illuminated.

**PART 3 EXECUTION**

3.01 INSPECTION

A. Verify that openings have been completely prepared in accordance with manufacturer's requirements. Notify Architect of conditions detrimental to operable wall installation and operation.

3.02 INSTALLATION

A. General: Comply with ASTM E557, operable panel partition manufacturer's written installation instructions, Drawings, and approved Shop Drawings.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.

3.03 DEMONSTRATION Y? or N?

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

1. Test and adjust seals, hardware, carriers, tracks, pass doors, pocket doors, exit signs and other operable components. Replace damaged or malfunctioning operable components.

2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

END OF SECTION
SECTION 10 26 00
WALL PROTECTION

PART 1   GENERAL

1.01  WORK INCLUDED
Select for scope - which will determine which of 2.01 thru 2.07 will be edited / then edit

A. Work under this section includes the following: select
1. Resilient bumper guards.
2. Resilient wall panels.
3. Resilient corner guards.
4. Resilient wall guards/handrail.
5. Stainless steel handrail guards.
7. Stainless steel corner guards.

1.02  REFERENCE STANDARDS
2. ASTM E84 - Surface Burning Characteristics of Building Materials.
3. UL - Underwriters Laboratories Classifications.

1.03  QUALITY ASSURANCE

A. Manufacturer: Firm with minimum five years experience in successfully producing wall guards and wall panels similar to that indicated for this project.

B. Installer qualifications: Engage an installer who has no less than 3 years experience in installation of systems similar in complexity to those required for this project.

C. Fire performance characteristics: Provide engineered PETG wall protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 for Class 1 characteristics listed below:
   1. Flame spread: 25 or less
   2. Smoke developed: 450 or less

D. Impact Strength: Provide assembled wall protection units that have been tested in accordance with the applicable provisions of ASTM F476.

E. Chemical and stain resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.

F. Single source responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.

1.04  SUBMITTALS

A. Submit the following in accordance with Section 01 33 23.
B. Shop Drawings: Clearly indicate the following for each type of wall protector:
   1. Type of wall protector identified by manufacturer’s model numbers including profiles, sizes, accessories and finish.
   2. Types and sizes of wall anchors for each type of wall construction.

C. Samples: 6” long full size samples representative of each type of wall protector specified.

D. Manufacturer’s certification indicating compliance with ADA Accessibility Guidelines for Protruding Objects.

1.05 DELIVERY, HANDLING AND STORAGE

A. Products shall be delivered to job-site in original unopened packages bearing manufacturer’s labels.

B. Store and protect products in accordance with manufacturer’s recommendations.

PART 2 PRODUCTS

2.01 BUMPER GUARDS

A. Material

B. Size: Approximately 2-3/4” high x 1-1/8” wide.

C. Provide end closure caps of same material as cover.

D. Color: As selected by Architect.

E. Manufacturer: BG-30 (Acrovyn) by CONSTRUCTION SPECIALTIES (C/S) or equal by ALPAR, BALCO METALINES, KOROSEAL, PAWLING or IPC.

2.02 WALL PANELS

A. Description: Vinyl/acrylic sheet (.022”) factory bonded to 3/8” thick fiber board core. Factory bond moisture resistant balance sheet to backside of panel.
   1. Edges: Beveled; vinyl/acrylic sheet extending to all edge surfaces.
   2. Color: As selected by Architect.

B. Manufacturer: High Impact Panels (Acrovyn) by DECOGARD PRODUCTS or equal by BALCO METALINES, KOROSEAL, PAWLING or IPC.

2.03 RESILIENT CORNER GUARDS
A. Description: Assembly consists of extruded aluminum retainer (0.063") and textured high impact snap-in acrylic cover (0.11”).

B. Vinyl/Acrylic Cover: U.L. classified. Tested in accordance with ASTM E84 meeting both flame spread and smoke development requirements for Class 1 rating.
2. Smoke Developed: 250 - 450.

C. Wing Width: 2”.

D. Angle: 90 degrees.

[E. Length: 6'-0”].

F. Manufacturer: Type CGS-2 by BALCO/METALINES; FS-20 by CONSTRUCTION SPECIALTIES, INC.

G. Color: As selected by Architect.

2.04 RESILIENT WALL GUARDS/HANDRAIL

A. Material

B. Size: Approximately 5-1/2” high x 1-1/2” wide.

C. Provide end closure caps of same material as cover.

D. Color: As selected by Architect.

E. Manufacturer: HRB-4C by CONSTRUCTION SPECIALTIES, INC.; BALCO/METALINES.; PAWLING.

2.05 STAINLESS STEEL WALL GUARDS

A. Handrail Guards
1. Description: Stainless steel pipe, Type 304, Schedule 40, 1-1/2” diameter, satin finish.
2. Fabrication: Welded connections, grind smooth, no exposed fasteners permitted.
3. Mounting: Provide wall brackets with straight-in mounting with concealed fasteners. Provide expansion bolt type fasteners for concrete block or glazed tile construction.
4. Space brackets at approximately 5'-0” on center.
5. Return rail ends to close tight to walls.
6. Manufacturer: TUBULAR SPECIALTIES MFG., INC.; CRANEVEYOR CORP.; KDI PARAGON; WILKINSON COMPANY, INC.
B. Bumper Guards
   1. Description: 16 gauge, Type 430 stainless steel, satin finish, 6" high to line up with glazed tile coursing. Provide beveled edges.
   2. Adhesive: Type as recommended by guard manufacturer for substrate conditions encountered.
   3. Manufacturer: TUBULAR SPECIALTIES MFG., INC.; CRANEVEYOR CORP.; KDI PARAGON; WILKINSON COMPANY, INC.

Which 2.06 ??

2.06 STAINLESS STEEL CORNER GUARDS

A. Description: 16 gauge, Type 430, stainless steel with satin finish. Provide with 1/8" radius corner.
B. Wing Width: 2" typical.
C. Angles: As indicated. Custom angles required.
D. Length: From top of base to finish ceiling.
E. Adhesive: Types as recommended by corner guard manufacturer for substrates encountered.
F. Fasteners: Types as recommended by manufacturer for substrates encountered.
D. Manufacturer: BUCHANAN COMPANY, GAMCO, PAWLING CORPORATION.

2.06 STAINLESS STEEL CORNER GUARDS

A. Description: 16 gauge, Type 430, stainless steel with satin finish. Provide with 1" radius bullnose and adjustable metal anchors for mortar joint installation.
B. Wing Width: 4-1/2" typical.
C. Angle: 90 degrees and 135 degrees as required.
D. Length: 6'-0".
E. Manufacturer: WCGT by WILKINSON COMPANY, INC.; BN-4548H by TUBULAR SPECIALTIES MFG., INC.

2.07 STAINLESS STEEL WALL COVERING

A. Description: 16 gauge, Type 430, stainless steel with satin finish.
B. Height: As indicated on drawings.
C. Adhesive: Types as recommended by corner guard manufacturer for substrates encountered.
D. Manufacturer: BUCHANAN COMPANY, GAMCO, PAWLING CORPORATION.
PART 3  EXECUTION

3.01  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. Do not proceed until unsatisfactory conditions have been corrected.

3.02  PREPARATION

A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer’s instructions.

B. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer’s installation instructions.

3.03  INSTALLATION

A. Install items in accordance with manufacturer's instructions and directions.

B. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.

3. Adjust termination caps as required to ensure tight seams.

C. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.04  CLEANING

A. Remove protective material from all wall protectors and clean in accordance with manufacturer's recommendations.

B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

3.05  PROTECTION

A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION
PART 1  GENERAL

1.01  SCOPE

A. This section covers all toilet accessories. Extent of each type of accessory is indicated on the drawing and specified herein.

B. Included are accessories for:
   1. Toilet rooms.
   2. Locker/Shower rooms.
   4. Kitchens, Break Rooms and similar areas with sinks.
   5. Laboratories.

C. Coordinate toilet partition mounted items with partition manufacturer for proper fastener reinforcements.

If so … need itemized to list

D. Also included is installation of Owner furnished items. These items are listed herein. Coordinate obtaining items from Owner and installation. Provide Owner with a minimum 72 hours notice prior to installing items. Contractor shall be responsible for items damaged or missing after being received from Owner.

1.02  WORK SPECIFIED IN OTHER SECTION

A. Unframed Mirrors: Section 08 81 00.

1.03  QUALITY ASSURANCE

A. Provide each type of products of one manufacturer. Provide locks with same keying for all accessory units in the project.

B. Stamped names or labels on exposed faces of units not permitted.

1.04  SUBMITTALS

A. Submit manufacturer's product data and installation instructions for each type of toilet accessory required.

1.05  DELIVERY, STORAGE AND HANDLING

A. Delivery accessory items in manufacturer's original, unopened packaging.

B. Store and handle materials in accordance with manufacturer's recommendations. Protect against soiling, damage and wetting.
1.06 PROJECT CONDITIONS

A. Furnish anchoring devices and inserts for installation of toilet accessories. Coordinate delivery of items which must be set or built into other work.

B. Provide setting drawings, templates and instructions for installation of anchorage devices.

1.07 WARRANTY

A. Submit mirror manufacturer's written ten year warranty against silver spoilage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Where a manufacturer's product is specified as a Basis of Design, equal products as manufactured by BOBRICK, BRADLEY, AJW, AMERICAN SPECIALTIES, may be used provided the product meets the requirements of the specifications, unless otherwise indicated.

2.02 ITEMS

A. Toilet Paper Holder: ADA compliant, open non-controlled.
   1. Double Roll: ASI Model 74022 SSM.
      a. Type: Surface Mount.

   1. Toilet Partition Mounted (Serves two compartments): BRADLEY Model 5422.
   3. Cabinet: Hinged 22 gauge stainless steel with tumbler lock.
   4. Capacity: Two standard core toilet tissue rolls through 5" in diameter.

A. Toilet Paper Holder - Jumbo: ADA compliant, partition mounted.
      a. Cabinet: Stainless steel with tumbler lock.
      b. Capacity: one roll (up to 10" diameter) of 1", 2 1/8" or 3" diameter core toilet tissue (by using core adapters)

B. Soap Dispenser - Horizontal Tank Type: BRADLEY Model 6542
   1. Type: Surface mounted, liquid dispenser.

B. Soap Dispenser - Vertical Tank Type: BRADLEY Model 6562
   1. Type: Surface mounted, liquid dispenser.

C. Soap Dispenser - Pump Type: BRADLEY Model 6324
1. Type: Countertop mounted, liquid dispenser.
5. Spout: 4".

D. Soap Dish: BRADLEY Model 900.
1. Material: Stainless Steel, 7 ga., type 304.
2. Finish: Satin.

E. Handicap Bars: BRADLEY Series 812
1. Diameter: 1-1/2 inch.
3. Fasteners: Concealed.
4. Style and Length
   a. As indicated; where not indicated provide 42" long horizontal and 18" vertical bars.
   b. Provide both horizontal and vertical bars in conformance with ANSI A117.1, 604, 608 and 609.

F. Paper Towel Dispenser: BRADLEY Model 250-15
1. Type: Surface mount with lockable hinged front cover.
2. Capacity: 500 multi or 300 C-fold towels.

F. Paper Towel Dispenser: BRADLEY Model 2494
1. Type: Sensor activated surface mount with lockable hinged front cover.
2. Capacity: Dispenses non-perforated roll towels up to 8" in diameter and 8" wide with core sizes from 1½”–2". Dispenser shall allow for 3" diameter stub roll.
4. Unit to be capable of being combined with waste receptacle to create a multi-purpose cabinet.

1. Type: Recessed with lockable hinged covers.
3. Capacities
   a. Dispenser: 800 multi-fold; 500 C-fold.
   b. Waste Receptacle: 4.2 gallon.

1. Type: Semi-recessed, removable 18 gal. container with vinyl liner. Secure to cabinet with keyed lock.
   1. Types: Partition insert mount type which serves two compartments and
      surface mounted type which serves end compartment of odd numbered
      compartments.

   1. Type: Surface mounted on toilet partition. Hinged bottom for disposable
      liner removal.

   1. Type: Recessed, coin operated (25 cent operation).
   3. Capacities

L. Toilet Seat Cover Dispenser: BRADLEY Model 584.
   1. Type: Recessed.
   2. Description: Stainless steel, hinged, lockable cover.

M. Robe/Towel Hook: BRADLEY Model 9119-81
   1. Type: Wall mounted, concealed fastener.

N. Mirrors
   1. Standard Framed Type: BRADLEY Model 780.
      a. Frame: Stainless steel angle, theft resistant concealed fasteners.
      b. Glass: [Tempered] [Float] 1/4" thick with full silver coating, copper
         coating and organic coating. Warranted by manufacturer 10 years
         against silver spoilage.
      c. Size: 18" wide x 36" high, unless otherwise indicated or scheduled
         on the drawings.
      a. Type: Fixed tilt.
      b. Frame: Stainless steel angle, theft resistant concealed fasteners.
      c. Glass: [Tempered] [Float] 1/4" thick with full silver coating, copper
         coating and organic coating. Warranted by manufacturer 10 years
         against silver spoilage.
      d. Size: 18" wide x 30" high, unless otherwise indicated or scheduled
         on the drawings.
   3. Unframed Type: Section 08 81 00.

O. Mop Strip: BRADLEY Model 9953.
   1. Description: Stainless steel, satin finish back plate with three spring
activated rubber cam mop holders.

2. Location: Provide at each janitors sink. Coordinate height with Architect.

P. Shower Curtain and Hooks: BRADLEY Models 9533 and 9536:
1. Provide 6 gauge, 100% vinyl material with hemmed edges and rust proof grommets. Field verify for height and width.
3. Provide quantity of hooks as required.

Q. Shower Curtain Rod: BRADLEY Model 9539
1. Description: Type 304, 18 gauge stainless steel.
2. Diameter: 1-1/4".
3. Length: Field verify.
4. Provide with mounting flanges and escutcheons.

1. Description: Folding type. Right or left hand as indicated or as required for field conditions.
2. Frame: Stainless steel tubing, type 304, 18 gauge.
3. Seat: Solid phenolic; color as selected by Architect.

S. Electric Hand Dryer: WORLD DRYER CORPORATION Model A.
1. Type: Surface mount.
2. Electrical: 115V, 20 amp, 1/10 hp, UL approved.
3. Time Cycle: 30 seconds.
5. Warranty: 10 years.
6. Other Acceptable Manufacturers: AMERICAN DRYER and other manufacturers listed in Article 2.01.

T. Electric Hair Dryer: WORLD DRYER CORPORATION Model B.
1. Type: Surface mount.
2. Electrical: 115V, 20 amp, 1/10 hp, UL approved.
3. Time Cycle: 80 seconds.
5. Warranty: 10 years.
6. Other Acceptable Manufacturers: AMERICAN DRYER and other manufacturers listed in Article 2.01.

U. Infant Changing Table
1. Description: Surface mount, fold down type. Concave molded polyethylene changing surface with safety strap. Folds up flat against wall when not in use. Provide with integral sanitary liner holder.
   a. Sanitary Liners: Provide 2 cases (approximately 2,800) disposable liners.
2. Manufacturer Koala Bear Kare Horizontal Baby Changing Station by KOALA CORPORATION or equal by BROCAR PRODUCTS, FOUR D, INC. or other manufacturers listed in Article 2.01.

V. Child Protection Seat
1. Description: Surface mount; FDA approved, high impact molded polyethylene construction able to withstand 150 lbs. static load. Rounded corner construction; approximately 12" wide x 19" long x 5-3/4" deep seat. Provide with polypropylene safety straps.

2. Manufacturer: Koala Bear Kare Child Protection Seat by KOALA CORPORATION, BROCAR, FOUR D, INC. or other manufacturers listed in Article 2.01.

W. Diaper Vending Machine
   1. Type: Recessed, vertical.
   4. Coin Operation: Settings from $0.25 to $1.00.
   5. Manufacturer: Koala Diaper Dispenser KOALA CORPORATION, BROCAR, FOUR D, INC. or other manufacturers listed in Article 2.01.

X. Janitor Closet Shelves: BRADLEY Model 7512
   1. Type: Surface mounted.
   3. Length: 24".
   4. Depth: 12".

2.03 FABRICATION

A. Edges: All throat openings and similar type exposed edges of towel dispensers, seat cover dispensers, waste receptacles and similar type accessories to be hemmed or sufficiently rounded to preclude accidental cuts to users.

B. Miters: Provide one-piece seamless beveled or return flange; open miters, if not welded, must be worked to eliminate sharp edges; edges which may cut or snag are not acceptable.

2.04 SCHEDULE OF ACCESSORIES

A. Toilet Room - Men 149 and Men 240

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>NUMBER REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet Paper Holder</td>
<td>1 double roll/stall</td>
</tr>
<tr>
<td>Soap Dispenser</td>
<td>3</td>
</tr>
<tr>
<td>Handicap bars</td>
<td>2; 42&quot;</td>
</tr>
<tr>
<td>Towel Dispenser/Waste Receptacle</td>
<td></td>
</tr>
<tr>
<td>Mirrors - Unframed</td>
<td>Approximately 12'-0&quot; x 2'-6&quot;</td>
</tr>
</tbody>
</table>

(Field verify for sizes; vertical joints as indicated or as directed by Architect.)

2.04 SCHEDULE OF ACCESSORIES

A. Location, quantity and mounting height of accessories as indicated on drawings.

B. Keyed Units: Key all similar types of units alike. Provide two keys per unit.
PART 3  EXECUTION

3.01  INSPECTION

A. Installer: Examine substrates, previously installed inserts anchorages necessary for mounting of accessories and other conditions under which installation is to occur.
   1. Notify Contractor in writing of conditions detrimental to proper and time completion of the work.
   2. Do not proceed with work until satisfactory conditions have been corrected.

3.02  INSTALLATION

A. Install in accordance with manufacturer's instructions using fasteners which are appropriate for substrate and recommended by manufacturer of unit. Install units and plumb and level, firmly anchored in positions indicated.

B. Provide concealed fasteners wherever possible of types required for substrate conditions encountered.
   1. Metal Stud and Gypsum Board: Screws or bolts anchored to 16 gage (minimum) metal plate blocking or wood blocking located within stud space. See Section 09 21 16 or [06 10 00] [06 10 50].
   2. Concrete Masonry Units: Integral fasteners (i.e. expansion anchors, etc.).

C. Lead, plastic or fiber plugs are not acceptable.

D. Grab Bars: Coordinate grab bar locations as to right hand or left hand installations with field conditions.
   1. Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F446.

E. Upon completion of installation, adjust each accessory unit for proper operation and clean exposed surfaces. Turn over keys to designated Owner's personnel.

END OF SECTION
SECTION 10 44 00
FIRE EXTINGUISHERS AND CABINETS

PART 1   GENERAL

1.01  WORK INCLUDED

A. Provide fire extinguishers and cabinets as shown and specified; provide units with wall brackets in non-finished areas (i.e. mechanical rooms, electrical rooms, etc.).

1.02  RELATED SECTIONS

A. Masonry (coordination for recessed cabinets): Section 04 00 00

B. Basis of Design for fire extinguishers: Division 21

1.03  QUALITY ASSURANCE

A. Provide fire extinguishers complying with Fire Protection Association (NFPA) Pamphlet No. 10; and as described in Division 21.

B. Provide only new portable fire extinguishers fully loaded, tested and approved by Underwriter's Laboratories (UL), and ready for use.

C. Fire-Rated, Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

1.04  SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Samples: Submit 6" x 6" sample for each type of exposed finish required.

1.05  COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of recessed fire protection cabinets with wall depths.

1. Coordinate location of fire extinguisher cabinets prior to construction of concrete masonry walls. Verify recessed type installations and coordinate these locations with the masonry construction.

a. Provide mason with rough opening size of cabinets.
PART 2  PRODUCTS

2.01  ACCEPTABLE MANUFACTURERS

A. Portable Fire Extinguishers
   1. AMEREX CORP.
   2. CROKER-STANDARD
   3. WALTER KIDDE, THE FIRE EXTINGUISHER CO.
   4. J. L. INDUSTRIES
   5. LARSEN’S MANUFACTURING COMPANY
   6. POTTER-ROEMER
   7. WATROUS

B. Fire Extinguisher Cabinets
   1. CROKER-STANDARD
   2. J.L. INDUSTRIES
   3. LARSEN’S MANUFACTURING COMPANY
   4. POTTER-ROEMER
   5. WATROUS
   6. THE WILLIAMS BROTHERS CORP.

C. Where a specific manufacturer's product is specified herein it is to establish a level of quality. Products by the other manufacturers listed are acceptable providing they meet these specifications.

2.02  FIRE EXTINGUISHERS

A. Multipurpose Dry-Chemical Type: Fabricate in accordance with NFPA No.10, 10A, and 10L and UL Standards, except hose, gauge face cover, and horn cone parts shall be metal. No plastic or nylon valves, trigger/handle, casing, or gauge will be acceptable. Fire extinguishers, unless indicated otherwise, shall be 10 lb. multi-purpose dry chemical type for use on A, B, and C fires (4A-60BC), with hose and horn. Provide this type throughout facility, unless noted otherwise.

B. Wet Chemical Type: Fabricate in accordance with NFPA No.10, 10A, and 10L, UL Standards, and State Codes, except hose, gauge face cover, and horn cone parts shall be metal. No plastic or nylon valves, trigger/handle, casing, or gauge will be acceptable. Wet chemical extinguisher types specified in Division 21

C. Size: 21-1/2" high x 8-1/2” wide x 5” deep; unless otherwise indicated.

2.03  FIRE EXTINGUISHER CABINETS

A. Provide steel construction, unless stainless steel is otherwise indicated.

B. Basis of Design: Drawings and specifications are based on LARSEN Architectural Line with full glass door. LARSEN catalog numbers are listed to establish a standard of quality and mounting type. Equal products may be provided from the listed acceptable manufacturers. Provide the following wall mounting types where a specific type of cabinet is indicated on the drawings. Where no type is indicated, provide recessed units.
2. Surface Mount - Steel: 2409-SM.
3. Semi-Recessed - Steel: 2409-6R.
5. Surface Mount - Stainless Steel: SS-2409-SM.
6. Doors
   a. Damage resistance / security areas: Solid
   b. All Other Areas: Full glass

C. Coordinate final model size with fire extinguisher.

D. Finish
   1. Steel: Baked enamel, white.
   2. Stainless Steel: No. 4.

E. Mounting Brackets: Provide manufacturer's standard plated finish, heavy duty mounting brackets for surface mounted fire extinguishers. Provide proper size and type for capacity of extinguishers indicated.

F. Fire Rated Cabinets: Listed and labeled to meet requirements of ASTM E814 for fire resistance rating of wall where it is installed.
   1. Construct fire rated cabinets with double walls fabricated from 0.0478 inch thick, cold rolled steel sheet lined with minimum 5/8 inch thick, fire barrier material.

G. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate the words "FIRE EXTINGUISHER" vertically on cabinet door.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

2.04 CABINET FABRICATION

A. Provide standard steel box with trim, frame, door and hardware to suit cabinet type, trim style and door indicated. Weld all joints and grind smooth; miter and weld door frames. Fabricate trim in one piece with corners mitered, welded and ground smooth. Open miters are not acceptable.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate location of fire extinguisher cabinets prior to construction of concrete masonry walls. Verify recessed type installations and coordinate these locations with the masonry construction. Provide mason with rough opening size of cabinets

3.02 INSTALLATION

A. Install fire extinguishers and fire extinguisher cabinets where indicated or as directed by Architect in accordance with manufacturer's recommendations. Mount
at heights indicated, when not indicated as directed by Architect.

B. Securely anchor brackets and cabinets to substrate construction with toggle bolts or expansion anchors. Lead, wood or plastic plugs and fasteners are not acceptable.

C. Fire extinguishers are to be fully charged and ready for use when building is turned over to the Owner. Extinguishers shall be certified as fully charged by an approved fire extinguisher service company and shall be tagged or labeled as such.

3.03 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION
PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide metal lockers in arrangements, layouts and quantities indicated. Section also includes:
   1. Pedestal benches.

B. Provide five (5) per cent of lockers as ADA compliant. Coordinate location with Architect. Location to be coordinated with locker design and placement of shelves.

1.02 RELATED SECTIONS

A. Sustainable Design Requirements: Section 01 81 13.

B. Built-in wood benches (locker bases): Section 06 40 00.

C. Coin Operated Metal Lockers: Section 10 51 14.

1.03 QUALITY ASSURANCE

A. Provide lockers as complete units produced by one manufacturer, including necessary mounting accessories, fittings and fastenings.

B. Contractor responsible for obtaining dimensions of locker space prior to manufacture and installation.

C. Reference Standards
   1. American Society for Testing and Materials (ASTM)
      a. ASTM A366 “Commercial Quality (CS) Steel, Carbon, (0.15 Maximum Percent) Cold-Rolled”.
      b. ASTM A569 “Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial”.
   2. Americans with Disabilities Act Accessibility Guidelines (ADA or ADAAG).

1.04 SUBMITTALS

A. Submit manufacturer's product data and installation instructions.

B. Submit shop drawings indicating materials, sizes, layouts, accessories, color, numbering and methods of installation.

C. Submit color charts for color selection.

1.05 DELIVERY, STORAGE AND HANDLING
A. Do not deliver lockers until buildings are permanently enclosed and ready for locker installation.

B. Protect lockers from damage during delivery, storage, handling and installation.

**PART 2   PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: ASI, PENCO, DeBOURGH, LIST INDUSTRIES, REPUBLIC.

2.02 MATERIALS AND COMPONENTS

A. Sheet Steel: ASTM A 1008, Class I, mild-annealed, cold-rolled steel, free from surface imperfections.

B. Expanded Metal: ¾" mesh flattened carbon steel.

C. Fasteners: Cadmium, zinc or nickel plated steel. Exposed heads slotless type. Provide self-locking nuts or lock washer for nuts on moving parts.

D. Hooks: Ball end, cadmium plated, forged steel.

E. Identification Plates: Provide each locker opening with aluminum number plate with approximately 3/8" high numerals. Rivet plate to door frame or door. Number lockers as directed by Architect.

2.03 and/or 2.04

2.03 VENTILATED TYPE LOCKERS

A. Lockers
   1. Arrangement and Layouts: As indicated.
   2. Sizes: As indicated.

B. Sides: 13 gage flattened expanded metal with 16 gage frames or 16 gage perforated metal.

C. Backs: Minimum 18 gage steel. Flange backs on vertical edges and sides where they enter member with backs, making double flanged rear corners. Provide all lockers with full solid back panels, except as follows:
   1. Back to Back Installations: Provide 13 gage flattened expanded metal or 18 gage perforated backs in lieu of solid backs.

D. Tops and Bottoms: Minimum 16 gage steel, flanged edges.
   1. Provide field installed 20 gage steel sloping top at all freestanding lockers. Sloping top is in addition to flat top.

E. Doors: One-piece minimum 14 gage steel, flanged at all edges. Construct doors to prevent springing when opening and closing. Fabricate doors to swing 180 degrees. Provide with diamond perforations.
1. Provide door arrangement as indicated.

F. Locking Devices: Positive automatic type locking device of pre-locking type. Manufacturer's standard recessed handle type containing hole for padlock attachment.
   1. ADA Compliant Lockers: Lever handle with opening function occurring with 30° or less rotation. Handle shall return to the locked position when released; turning lever will cause door to pop open and remain ajar. Locate approximately 34” above the floor.

G. Equipment: Provide one hat shelf approximately 9” below top of locker, one double prong back hook and one single prong wall hook on each side of each locker opening.
   1. ADA Compliant Lockers: Provide shelf at a maximum of 54” above floor (where side access is permitted) or 48” above the floor (where front access only is permitted); provide additional shelf where bottom of locker is less than 9” above the floor.

H. Provide all required closures and trims. Minimum 16 gage.

2.04 SOLID DOOR TYPE LOCKERS

A. Lockers
   1. Arrangement and Layouts: As indicated.
   2. Sizes: As indicated.

B. Lockers shall have a "quiet" lock bar assembly. Moving parts within door shall be cushioned by rubber or other means to achieve maximum sound suppression.

C. Frames: Minimum 16 gage channels or 12 gage angles, with corners welded to form a rigid one-piece structure. Form door stops at vertical members.

D. Backs and Sides: Minimum 18 gage steel. Flange backs on vertical edges and sides where they enter member with backs, making double flanged rear corners. Provide all lockers with full back panels.

E. Tops and Bottoms: Minimum 18 gage steel, flanged edges.

F. Doors: Minimum 16 gage steel, flanged at all edges. Construct doors to prevent springing when opening and closing. Fabricate doors to swing 180 degrees. Provide louverless solid door fronts with door perimeter ventilation equal to vent area provided by standard door louvers. Provide rubber door silencers at latches.
   1. Provide door arrangement as indicated.

G. Door Hinges: Heavy duty, not less than 0.050" thick steel, full loop, five knuckle, tight pin, minimum 2" high. Weld hinges to inside of frame and secure to door with minimum two factory installed fasteners, completely secured and tamperproof when locker door is closed.

H. Latching Device: Positive automatic type locking device of pre-locking type.
[1. Locking - Padlock: Manufacturer's standard recessed handle type containing hole for padlock attachment.]

[1. Locking - Built-in Combination Lock: Key-controlled, 3-number dialing type with combination change made automatically by use of control key. Provide automatic dead bolt action.]

2. ADA Compliant Lockers: Lever handle with opening function occurring with 30° or less rotation. Handle shall return to the locked position when released; turning lever will cause door to pop open and remain ajar. Locate approximately 34” above the floor.

I. Equipment: Provide one hat shelf approximately 9” below top of locker, one double prong back hook and one single prong wall hook on each side of each locker opening.

1. ADA Compliant Lockers: Provide shelf at a maximum of 54” above floor (where side access is permitted) or 48” above the floor (where front access only is permitted); provide additional shelf where bottom of locker is less than 9” above the floor.

J. Exposed Sides: Provide minimum 16 gage end panels.

K. Provide all required closures and trims. Minimum 16 gage.

L. [Provide sloping locker tops in addition to the locker-section flat tops. Sloping tops must be continuous in length. Provide fillers or closures at the exposed end of sloping tops. Fabricate sloping tops from not less than 0.0478-inch thick steel sheet.]

2.05 FABRICATION AND ACCESSORIES

A. Construction: Fabricate lockers square, rigid, without warp and with exposed metal faces flat and free of dents or distortions. Make all exposed metal edges safe to touch.

B. Solid Door Type: Weld frames together. Unless otherwise indicated, weld, bolt or rivet other joints and connections as standard with manufacturer.

C. Ventilated Type: All welded construction.

2.06 STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust and other contaminants that could impair paint bond.

B. Baked Enamel Finish: Immediately after cleaning and pre-treating, apply manufacturer's standard baked-on enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum 1.4 mils dft on doors, frames and legs and 1.1 mils dft on other surfaces.

C. Colors: As selected by Architect. Paint interior the same color as exterior.
2.05 BENCHES

A. Description: Provide wood bench mounted on steel pipe pedestals, bolted to floor.

B. Size: 18" high x 9-1/2" wide x 1-1/4" thick x nominal length as indicated on drawings.

C. Top: Laminated maple, natural finish.

D. Manufacturer: Same as Locker Manufacturers listed in paragraph 2.01A herein.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install lockers in accordance with manufacturer's instructions. Install units plumb, rigid and level, located as indicated on drawings.

B. Apply fastenings through back up reinforcing plates where necessary to prevent metal distortion. Conceal fasteners whenever possible.

C. Install recessed locker trim. Provide flush hairline joint against adjacent surfaces. Install trim with concealed fasteners.

D. Touch-up marred finished, using materials as recommended or furnished by manufacturer. Replace units that cannot be satisfactorily repaired as directed by the Architect.

E. Adjust doors and latches to operate easily without binding. Verify satisfactory operation of integral locking devices.

3.02 ADJUSTING, CLEANING, AND PROTECTING

A. Clean, lubricate and adjust hardware, Adjust doors to operate easily without binding.

B. Protect lockers from damage, abuse, dust, dirt, stain or paint. Do not permit use during construction

END OF SECTION
PART 1  GENERAL

1.01  SCOPE
A. Provide front loading, lockable mailboxes. Provide arrangements, layouts, box sizes and quantities as indicated on drawings.

Provide rear loading, lockable mailboxes. Provide arrangements, layouts, box sizes and quantities as indicated on drawings.

1.02  SUBMITTALS
A. Submit manufacturer's product data, layout drawings and installation instructions in accordance with the General Conditions.

PART 2  PRODUCTS

2.01  MAILBOXES
A. Description: Front load, horizontal type. Fabricated from extruded aluminum, with anodized duranodic finish.

A. Description: Rear load, horizontal type. Fabricated from extruded aluminum, with anodized duranodic finish.
1. Size: Approximately 5" high x 6-3/8" wide x 1'-5" deep. Combine 7 mailboxes high and 4 or 3 wide for a total of 27 or 20 usable per group. Provide groups to service the 89 units, as indicated on drawings.
2. Door Locks: 5 pin cylinder cam type. Provide 2 keys per mailbox.
3. Door Numbers: 1/2" high engraved numbers on each door. Number units as directed by the Owner.

B. Fabrication: Provide units completely factory assembled, no field assembly.

C. Manufacturer: SALSBURY INDUSTRIES 48B+ Standard or equal products by FLORENCE MANUFACTURING; CUTLER MANUFACTURING CORPORATION; BOMMER INDUSTRIES; AMERICAN DEVICE.

PART 3  EXECUTION

3.01  INSTALLATION
A. Install mailbox assembly in accordance with the manufacturer's recommendations. Anchor units securely to wall structure. Trim opening with flanged trim provided by mailbox manufacturer, finished to match mailboxes.

END OF SECTION
SECTION 11 24 23

WINDOW WASHING SYSTEM

PART 1  GENERAL

1.01  SUMMARY

A. This Section includes, but is not limited to, design and furnishing portable davits, davit sleeves, and davit bases, including fasteners and appurtenances as required or necessary for complete installation.

B. Products Furnished But Not Installed Under This Section:
   1. Davit bases, anchor bolts and lifeline tie-backs.
   2. Quick release intermittent stabilization anchors and inserts on building facade.

1.02  SYSTEM REQUIREMENTS

A. Delegated Design: Design cold formed metal framing assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design Requirements: Manufacturer is responsible for designing system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
   1. Employ registered professional engineer, licensed to practice structural engineering in jurisdiction where Project is located, to engineer each component of window washing system.
   2. Comply with ANSI A39.1, A120.1, and OSHA 1910.28 and 1910.66.
   3. All Vertical Surfaces of Building Exterior: Accessible by means of powered platform or other means included as work of this Section.

C. Performance Requirements: Installation: Withstand 50 MPH wind velocities while being used and remain fully operational at wind velocities up to 25 MPH.
   1. Suspension Rope Angulation and Tie-In Lanyard System: Design to ensure minimum force of 10 pounds against face of building.

D. Structural Requirements: Engineer structural assemblies, davits, sockets and socket bases and components to carry minimum load of 1000 pounds at extreme cable attachment point with minimum safety factor of 4 to 1 against failure.
   1. Provide intermittent stabilization anchors capable of resisting 600 pound load perpendicular and parallel to face of building.

1.03  ACTION SUBMITTALS

A. Product Data: Include major equipment items.

B. Shop Drawings: Stamp shop drawings with seal and signature of professional engineer responsible for design.
1. Submit plans, sections, elevations and details showing sizes, arrangements, materials, thicknesses, finishes, dimensions and other data to clearly explain character and nature of proposed equipment.
2. Include location diagrams for inserts, davits, outriggers, quick release stabilizer anchors, and other items to be built into structure.
3. Submit sequence drawings to illustrate cleaning of all exterior surfaces of building facade from platform; show intended operations can be accomplished in safe and unencumbered manner in conformance with codes and regulations having jurisdiction.
4. Provide large scale roof plans and elevations showing equipment in various positions at various launch points to ensure that clearances and space restrictions have been considered and accommodated. Show special details to allow placement of platforms at each washing position.
5. Verify Project conditions affecting work of this Section and obtain accurate measurements for incorporation into shop drawings.

C. Submit changed condition drawings.

1.04 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Submit following packaged separately from other submittals:
1. Design Data: Submit following information with proposal for review by Architect.
   a. Indicate weights of major assemblies including davits.
2. Support reactions design data.
3. Test Reports: Field test reports signed by independent testing laboratory, verifying compliance with specified and regulatory requirements.
4. Certifications specified in Quality Assurance article.
5. Qualification Data: Manufacturer's, engineer's, and installer's qualification data.
6. Manufacturer's instructions.

1.05 CLOSEOUT SUBMITTALS

A. Closeout Submittals: Submit maintenance data in accordance with Section 01 78 21.
1. Include step-by-step operating procedure directions, parts list, equipment checklist, schematic wiring diagrams, and procedure to be followed during emergency operations.
2. Provide maintenance checklist broken down on weekly, monthly and yearly basis, describing procedures to be followed, time intervals, and materials to be used. Include names, addresses, and telephone numbers of service firms in vicinity of building available to respond within 24 hours of service call.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility: Provide window washing components and systems from same manufacturer or approved by manufacturer.

B. Engineer Qualifications: Registered professional engineer licensed to practice
structural engineering in jurisdiction where Project is located, with minimum of five years experience in design of window washing systems.

C. Manufacturer's Qualifications: Firm solely involved in design, manufacture, and installation of power operated window washing units, that has been actively engaged in this business for not less than 10 years.
   1. Submit evidence when requested, indicating that firm has successfully installed at least three platform powered window washing units of similar type as proposed for use on this Project on buildings over 130 feet in height. Include one installation not less than five years old.
   2. Submit with proposal, concept drawing which demonstrates manufacturer's proposed solution to building requirements showing aspects that may deviate from Drawings and Specifications. Show coordination with building structure, intermittent stabilization locations, layout, plumbing requirements, electrical requirements, and loads imposed on building structure along with description of proposed system operation.

D. Installer Qualifications: Installer employed by manufacturer or approved in writing by manufacturer.

E. Welder Qualifications: AWS certified within past 12 months for each type of weld required.

F. Regulatory Requirements:
   1. Electrical Components and Wiring: Comply with National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA) standards.
   2. Comply with federal, state and local codes, ordinances, and requirements pertaining to work of this Section.
   3. Where requirements of governing codes, regulations, laws and rules conflict with these Specifications and are mandatory, comply with regulatory requirements.

G. Certifications: Submit following:
   1. Engineering certifications.

1.07 PRE-INSTALLATION CONFERENCE

A. Conduct pre-installation conference in accordance with Section 01 31 00.
   1. Plan necessary coordination with structural, curtain wall, roofing, plumbing, and electrical trades.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Shop fabricate window washing equipment in sizes as large as practical. Deliver to Project properly packaged and crated to prevent damage during transit and handling.

B. Store materials under cover in dry, clean location, off ground. Remove materials which are damaged or otherwise not suitable for installation from Project and replace with acceptable materials.
1.09 MAINTENANCE


PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products from one of the following:
   1. Equicon, Inc.
   4. Sky Climber, Inc.
   5. Spider Staging Corporation
   6. Swingstage Inc.

2.02 MATERIALS

A. Metals:
   1. Aluminum Alloy: Alloy 6061-T6, Schedule 80, designed in accordance with ANSI A120.1
   2. Steel Pipe: ASTM A53, Type E or S, Grade B.
   5. Stainless Steel Components: UNS S30400.

B. Connectors: Galvanized steel anchor bolts, ASTM A307 or A325.
   1. Fasteners Exposed to Weather and Carrying Calculated Stress: Galvanized or stainless steel.

C. Non-Shrink Grout: Non-shrink, non-ferrous, equivalent to Masterflow 713 by Master Builders.

2.03 WINDOW WASHING DAVIT AND SUPPORT ASSEMBLIES

A. Davit Socket Bases: Permanently attached to structure at locations indicated in accordance with Drawings and manufacturer’s recommendations.
   1. Socket Bases: Fabricate from pipe of such size and wall thickness suitable for design requirements. Perform welding in compliance with AWS D1.1.
   2. Gussets or other protrusions that interfere with flashing or roofing membrane not allowed.
   3. Socket Bases: Design to accommodate bolts or pins for attachment of portable sockets.
   4. Provide minimum of one anchor point for securing a safety line.
   5. Hot-dip galvanize steel after fabrication.

B. Portable Davit Sockets: Fabricated from seamless mechanical steel pipe or tubing with 4:1 factor of safety.
1. Hinge to permanently attached socket bases by means of stainless steel pins or bolts to permit insertion of davit into socket and subsequent tilting into working position.
2. Make provisions to securely lock davit in upright position.
3. Provide pneumatic tires for portability on roof area.
4. Hot-dipped galvanized steel finish unless otherwise indicated.

C. Davits: Fabricated of Schedule 80, 6061-T6 aluminum alloy pipe and sized to fit into davit socket fixtures.
   1. Rotatable type, designed to allow self-powered platform to be brought inboard over parapet to roof for transfer.
   2. Close end of each assembly with aluminum cast thrust bearing to ensure easy rotation. Fit upper base section with steel bearing sleeve to protect davit from abrasion when rotating in davit socket.
   3. Equip each davit with positive friction brake to prevent rotation of davit from desired work position.
   4. Hanger Bar: Equip each davit with multiple pick-up hanger bar to provide for variable suspension radius and to allow use of Type F (four wire) and Type T (two wire) work platforms.
      a. Construct hanger bar to permit suspension radius of at least 5 feet and minimum of approximately 46 inches.
      b. Provide at least three suspension points between maximum and minimum radii.

D. Safety Tie-Backs: Position directly behind each davit base and at right angles to building face or integral with permanently supported socket base.
   1. Where right angle spacing cannot be achieved, furnish two safety tie-backs for each davit location.
   2. Determine design for safety tie-back on davit reactions. However, do not consider safety tie-back in davit design.
   3. Hot dip galvanize safety tie-backs after fabrication.

2.04 ROPE STABILIZERS

A. Wire Rope Stabilizers: No rope in excess of 300 feet long hangs between stabilizers or between davit attachment point and stabilizer.

B. Stabilize power cord to building or support ropes at 100 foot intervals maximum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions and proceed with Work in accordance with Section 014000.

3.02 INSTALLATION

A. Window Washing Davits and Supports: Install in accordance with accepted shop and erection drawings and manufacturer’s recommendation and instructions.
   1. Coordinate with construction operations.
B. Davit Socket Base Plates: Install plumb and level with non-shrink grout placed in accordance with manufacturer's instructions.

3.03 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Inspections and tests of installation of anchors and bases permanently attached to structure will be performed by independent laboratory selected and paid by Owner.
   2. Perform inspections and tests in accordance with ASTM E329.
   3. Inspect field bolted connections in accordance with AISC requirements.
   4. For welding connections:
      a. Verify welders are qualified in accordance with American Welding Society requirements.
      b. Perform visual inspection of welds.
      c. Perform ultrasonic inspection of full penetration welds.
      d. Record types and locations of defects and work performed to correct defects.
   5. Obtain local and state inspections and permits. Make tests as required for regulations of authorities having jurisdiction.
   6. Conduct tests as required by regulation of state and local authorities having jurisdiction.

B. Permits: After installation is complete, obtain city, state and other authority documents, permits, and licenses necessary to operate window washing system. Owner's approval, acceptance, and payment will not be forthcoming until necessary permits and documentation have been approved and issued.

3.04 DEMONSTRATION

A. Manufacturer's Factory Trained Representative: After completion of installation, conduct full load and operation tests in accord with applicable standards under maximum design loading conditions and operate over full range (horizontally and vertically) of building surfaces to be maintained.

B. Manufacturer's Factory Trained Representative: Instruct Owner's designated personnel in complete operation and maintenance of installed system.

C. When necessary, make minor adjustments. Carefully document and submit adjustments to Owner.

END OF SECTION
SECTION 114000 - FOODSERVICE EQUIPMENT

PART 1 – GENERAL

1.1 SCOPE

A. Foodservice Equipment Contractor/Kitchen Equipment Contractor (KEC as abbreviated in documents) Scope: The work referred to in this section consists of furnishing all labor and material required to provide and deliver all equipment hereinafter specified into the building, uncrate, assemble, hang, set in place, level, and completely install, excluding final utility connection. The kitchen equipment contractor shall provide all equipment included in this section, including all foodservice equipment counters and equipment contained in such.

B. All foodservice equipment as shown on the foodservice equipment drawings will be provided through Foodservice Equipment Contractor/Kitchen Equipment Contractor (KEC as abbreviated in documents) as a subcontractor to the general contractor and set in-place. Items to be provided by the General Contractor or subcontractor will be indicated as such on the foodservice equipment drawings. General Contractor will be responsible for the rough-in of all utilities for the foodservice equipment. Final utility connection to include mechanical, electrical, plumbing and data/telephone as required will be provided by the General Contractor.

C. General Contractor will be required to coordinate with the kitchen equipment contractor regarding installation, schedule and completion of work.

D. Kitchen equipment contractor to coordinate with the owner and general contractor the installation of all equipment noted as Vendor and/or Owner supplied.

E. All equipment pricing to be submitted itemized with detailed costing per each item. No lump sum bids.

F. KEC to provide and install all beverage conduit as indicated on equipment drawings. Beverage conduit runs to be coordinated with general contractor and building trades.

1.2 SUBMITTALS – (Provided by Kitchen Equipment Contractor)

A. Upon award of Contract, furnish the Architect with hard copies of the following drawings, in accordance with the approved project schedule, which shall be made on sheets equal in size and matching the bid set drawing size. Reproduced copies of bid documents will not be accepted for this purpose in any fashion.

1. Equipment specified for fabrication shall be detailed and fully dimensioned to a minimum scale of \( \frac{3}{4}” = 1’-0” \) for plan and elevation views and \( 1-1/2” = 1’-0” \) for sections.

2. Prepare separate electrical and mechanical dimensioned rough-in drawings at \( \frac{1}{4}” = 1’-0” \) scale showing exact point of penetration of floors, walls, and ceilings for all services required to operate the equipment that the Contractor shall furnish. These drawings shall
also show exact locations of final connections to equipment. Indicate floor drains, floor sink, receptacles, lights, and other special conditions.

3. Dimensioned drawings shall be submitted showing the location and size of all bases, depressions, special height walls, openings in walls for equipment, and critical dimensions, etc. Drawings shall be drawn to a scale of not less than $\frac{1}{4}'' = 1'-0''$.

B. **Manufacturers’ Data**: Upon award of Contract, submit bound copies of Manufacturers’ Illustrations and Technical Data to the Architect for review prior to procurement. Items of Standard Manufacture shall be submitted, including items purchased to be built into fabricated equipment. Each illustration shall be marked to describe accurately the item to be furnished as specified, including voltage, phase, load, accessories, etc.

C. **Manufacturers’ List**: Submit in writing a list of all manufacturers’ representatives of the foodservice equipment, such as convection ovens, ranges, etc., and their authorized service agencies’ addresses and telephone numbers.

D. **Foundation Data**: Data and drawings shall be submitted for each item, if any, requiring special foundations, structures, or supports. Such foundations, structures, or supports will be provided and installed by other appropriate trades in accordance with the drawings and specifications which shall be provided by the Contractor and reviewed by the Architect.

E. **Operation and Maintenance Manuals**: Bound copies of operation, maintenance, and parts manuals shall be supplied for all equipment items of standard manufacture including standard component assemblies built into all custom-fabricated items.

F. Review by the Architect of the drawings and brochures submitted by the Contractor does not waive the responsibility of the Contractor to furnish each item of equipment in complete compliance with the specifications and contract drawings.

G. The number of copies of all submittals shall be as determined by the Architect.

H. **Samples**: Samples of materials, products, fabrication methods, and reworking of damaged areas or equipment shall be submitted for review upon request at no additional cost, before proceeding with the work.

1.3 **QUALITY ASSURANCE**

A. **Standard Products**: Materials, products, and equipment furnished under this contract shall be the standard items of manufacturers regularly engaged in the production of such materials, products, and equipment and shall be of the manufacturers’ latest design that complies with the specifications.

B. **Manufacturers’ Qualifications**: Manufacturers shall be regularly engaged in the production of the items furnished and shall have demonstrated the capability to furnish similar equipment that performs the functions specified or indicated herein.

C. **Installation Qualifications**: Contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with
the specified requirements and the methods needed for proper performance of the work defined in this Section.

D. Coordination of Work: Coordinate work with the respective trades performing preparatory work for installation of equipment under this Contract, including, but not limited to: construction of pits, trenches, receptors; rough-in of supply, waste and vent piping; electrical connections; and field verification of dimensions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver foodservice equipment in containers designed to protect equipment and finish until final installation. Make arrangements to receive equipment at project site or to hold in warehouse until delivery can be made to job site.

B. Store foodservice equipment in original containers and in location to provide adequate protection to equipment while not interfering with other construction operations.

C. Handle foodservice equipment carefully to avoid damage to components, enclosures, and finish. Do not install damaged foodservice equipment; replace and return damaged components to equipment manufacturer.

1.5 APPLICABLE CODES AND STANDARDS

A. Except as otherwise indicated, each item of equipment shall comply with the latest current edition of the following standards as applicable to the manufacture, fabrication, and installation of the work in this section. Comply with all Federal, State, and Municipal regulations and notifications which bear on the execution of this work.

1. NSF Standards: Comply with applicable National Sanitation Foundation standards and criteria and provide NSF “Seal of Approval” on each manufactured item and on major items of custom-fabricated work.

2. UL Standards: For electrical components and assemblies, provide either UL labeled products or, where no labeling service is available, provide a complete index of the components used as selected from the UL “Recognized Component Index.” All fabricated foodservice counters to by fabricated by UL listed fabricator and assembled to UL standard. Counter shall be pre-wired to subpanel provided in counter by KEC ready for final field connection electrical contractor. Exhaust hoods and fire suppression systems shall by UL300

3. ANSI Standards: Comply with applicable ANSI standards for electric-powered and gas-burning equipment. Comply with ANSI B57.1 for compressed gas cylinder piping and connections and with applicable standards of the Compressed Gas Association for water connection air gaps and vacuum breakers.

4. AGA: All gas-fired equipment shall be AGA approved, equipped to operate on the type gas available at the job site, and shall contain 100% automatic safety shut-off devices.

5. NFPA Standards: Comply with NFPA Bulletin 96 for exhaust systems; with NFPA Bulletins 13, 17, and 96 for fire extinguishing systems; and with NFPA 54, National Fuel Gas Code and NFPA 70, National Electrical Code.
6. ASME Code: Comply with ASME boiler code requirements for steam-generating and steam-heated equipment; provide ASME inspection, stamps, and certification of registration with National Board.

7. Americans with Disabilities Act (ADA): Call to the attention of the Owner in writing any design conflict with the requirements of the Americans with Disabilities Act (ADA) during Bid Process so resolution can be effected prior to Contract Award.

1.6 PROJECT CONDITIONS

A. Visit the job site to field check actual wall dimensions and roughing-in and be responsible for furnishing, fabricating, and installing the equipment in accordance with the available space and utility services as they exist on the job site for an accurate fit.

B. Check all door openings, passageways, elevators, etc., to be sure that the equipment can be conveyed to its proper location within the building and, if necessary, check with the Contractor regarding the possibility of holding wall erection, placement of doorjambs, windows, etc., for the purpose of moving the equipment to its proper location. Any removal and rebuilding of walls, partitions, doorjambs, etc., necessary to place the equipment or, if caused by incorrect information on the Contractor’s drawings, shall be done at the expense of the Contractor.

C. Physically check the location and utility size of all “rough-ins” at the job site for compatibility with the equipment being installed before finished floors, walls, and/or ceilings are in place.

D. Check electrical characteristics and water, steam, and gas pressure. Provide pressure-regulating valves where required for proper operation of equipment.

1.7 GUARANTIES AND WARRANTIES

A. Self-contained or remote refrigeration systems furnished under this Contract shall be provided with start-up and a one-year service contract providing free service, 24 hours per day, seven days per week, including parts and labor. Hermetic or semi-hermetic compressors shall be covered by the manufacturers’ factory warranty for an additional four years. Other equipment provided shall include a one-year warranty covering parts and labor, plus any extended warranties as normally provided by individual manufacturers. Equipment including refrigeration systems both self-contained and remote shall be warranted by the Contractor on the project for one year as indicated in the preceding sentence. The first day of the first year commences upon the earlier of 1) the date the equipment is put into production at the facility or 2) the date the equipment is accepted by the Architect.

PART 2 - PRODUCTS

2.1 GENERAL

A. The equipment and its component parts shall be new and unused. All items of standard manufactured equipment shall be current models at the time of delivery. Parts subject to wear, breakage, or distortion shall be accessible for adjustment, replacement, and repair.

B. Means shall be provided to ensure adequate lubrication for moving parts. Oil holes, grease fittings, and filler caps shall be accessible without the use of tools.
C. Plastic nameplates, to identify controls on fabricated equipment and when specified elsewhere, shall be provided of two-ply, 1/16", rigid plastic material which shall be specifically manufactured for engraving such nameplates. The finished nameplate shall be machine engraved with white letters on a black background and shall have edges beveled at a 45° angle. Nameplates shall be attached using an adhesive recommended by the manufacturer of the engraving material.

D. The design of the equipment shall be such as to provide for safe and convenient operation. Covers or other safety devices shall be provided for all items of equipment presenting safety hazards. Such guards or safety devices shall not present substantial interference to the operation of the equipment. Guards shall provide easy access to guarded parts.

E. Trim shall not be an acceptable substitute for accuracy and neatness. When trim is required and accepted by Architect in lieu of rejection of items of equipment, it shall be the Contractor’s responsibility to provide same at no additional cost.

F. Unless otherwise specified herein, no material lighter than #20 gauge shall be incorporated into the work. Gauges for sheet iron and sheet steel shall be U.S. Standard Gauges and finished equipment gauge thickness shall not vary more than 5% plus or minus from the thickness indicated below.

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<th>GAUGE</th>
<th>THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>#10</td>
<td>0.135</td>
</tr>
<tr>
<td>#12</td>
<td>0.105</td>
</tr>
<tr>
<td>#14</td>
<td>0.075</td>
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<tr>
<td>#16</td>
<td>0.060</td>
</tr>
<tr>
<td>#18</td>
<td>0.048</td>
</tr>
<tr>
<td>#20</td>
<td>0.036</td>
</tr>
</tbody>
</table>

G. Materials or work described in words which have a well-known and accepted technical or trade meaning shall be held to refer to such accepted meanings.

2.2 MATERIALS

A. Submit a certified copy of the mill analysis of materials if requested by the Architect.

B. Stainless steel sheets shall conform to ASTM A240, Type 304 Condition A, 18-8, having a No. 4 finish. A No. 2B finish shall be acceptable on surfaces of equipment not exposed to view. Sheets shall be uniform throughout in color, finish, and appearance.

C. Stainless steel tubing and pipe shall be Type 304, 18-8, having a No. 4 finish, and shall conform to either ASTM A213 if seamless or ASTM A249 if welded.

D. Rolled shapes shall be of the cold-rolled type conforming to ASTM A36.

E. Galvanized sheet steel shall conform to ASTM A526; where extensive forming to take place, conform to ASTM A527; conform to ASTM A525, coating designation G115, chemical treatment.
F. Galvanized steel sheets shall be cold-rolled, stretcher leveled, bonderized, and rerolled to ensure a smooth surface.

G. Castings shall be corrosion-resisting metal containing not less than 30% nickel. Castings shall be rough ground, polished, and buffed to bright luster and free from pit marks, runs, checks, burrs, and other imperfections. In lieu of corrosion-resisting metal castings, die-stamped or cast 18-8 stainless steel will be acceptable.

H. Not used

I. Sealant, wherever required, for sealing backsplashes to walls, cabinet bodies to concrete or tile bases, roll-in refrigerators to floors, or other types of application shall be Dow-Corning #780 or General Electric “Silastic” or equivalent in either clear or approved color to match surrounding surfaces and applied in accordance with sealant manufacturers’ recommendations for smooth, sealed finish.

2.3 FINISHES

A. Paint and coatings shall be of an NSF approved type suitable for use in conjunction with foodservice equipment. Such paint or coating shall be durable, non-toxic, non-dusting, non-flaking, and mildew resistant; shall comply with all governing regulations; and shall be applied in accordance with the recommendations of the manufacturer.

B. Exterior, galvanized parts, exposed members of framework, and wrought steel pipe where specified to be painted shall be cleaned, properly primed with rust-inhibiting primer, degreased, and finished with two (2) coats of epoxy-based grey hammer tone paint, unless otherwise specified.

C. Stainless steel, where exposed, shall be polished to a #4 commercial finish. Where unexposed, finish shall be #2B. The grain of polishing shall run in the same direction wherever possible. Where surfaces are disturbed by the fabricating process, such surfaces shall be finished to match adjacent undisturbed surfaces.

D. Galvanized shelving shall not be painted.

E. Fabricated equipment shall be spray coated with plastic suitable for protecting the equipment during transport and installation. The coating shall be easily removable and shall be removed after the equipment installation is complete at the work site or, alternatively, when directed by the Architect.

F. Exposed surfaces on brass, bronze, or steel shall be plated with chromium over nickel in accordance with Federal Specifications WW-P-541, Paragraph 9.5 and Table 9.4, unless otherwise specified.

2.4 ELECTRICAL AND MECHANICAL REQUIREMENTS
A. Standard UL listed materials, devices, and components shall be selected and installed in accordance with NEMA Standards and recommendations and as required for safe and efficient use and operation of the foodservice equipment without objectionable noise, vibration, and sanitation problems.

1. Provide recognized commercial grade signals, “on-off” pushbuttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent engraved, plastic laminate signs and graphics identifying each item. Provide stainless steel cover plates at controls and signals.

2. Each item requiring electrical power shall be equipped with either a terminal box for permanent connection or with cord and plug for interruptible connection, as indicated. Provide NEMA standard grounding type plugs, where used.

3. Furnish foodservice equipment completely wired internally using wire and conduit suitable for a wet location, including a separate grounding wire. Provide electrical outlets and receptacles required to be mounted on or in fabricated equipment and interconnect to a suitable terminal box (subpanel, starter, or disconnect switch if so specified) with all wires neatly tagged showing item number, voltage characteristics, and load information.

4. Receptacles for all wall- and floor-mounted outlets will be provided to be used for plug-in equipment with characteristics as noted on the drawings. Provide Hubbell three-wire or four-wire grounding-type connectors and neoprene cords installed on each item of plug-in equipment to match receptacles provided.

5. Electrically heated equipment shall be internally wired to a thermostatic control and an “on-off” red neon light indicator, which shall be mounted in a terminal box on a removable stainless steel access panel.

6. Only rigid steel conduit shall be used, zinc-coated where unexposed and chrome-plated where exposed. Wiring shall be run concealed wherever possible.

7. Provide on or for each motor-driven appliance or electrical heating or control unit, a suitable control switch or starter of the proper type and rating and in accordance with Underwriters Code wherever such equipment is not built in.

8. Appliances shall be furnished complete with motors, driving mechanism, starters, and controllers, including master switches, timers, cut-outs, reversing mechanism, and other electrical equipment if and as applicable. Wiring and connection diagrams shall be furnished with electrically operated machines and for electrically wired fabricated equipment.

9. Appliances shall be of rigid construction, free from objectionable vibration. Quietness of operation of all foodservice equipment is a requirement. Remove or repair any equipment producing objectionable noise and/or vibration as directed by the Architect.

10. Motors shall be of the drip-proof, splash-proof, or totally enclosed type, having a continuous duty cycle and ball bearings, except small timing motors which may have sleeve bearings. Motors shall have windings impregnated to resist moisture. Motors located where subject to deposits of dust, lint, or other similar matter from the machine on which installed shall be of the totally enclosed type. Motors shall have ample power to operate the machines for which designated under full load operating conditions without exceeding their nameplate ratings. Horsepower requirements on driven equipment shall be determined by the manufacturer based on normal operation at maximum capacity. The nominal rated motor horsepower shall be not less than the horsepower required for normal operation of the equipment at maximum capacity. Insulation shall be NEMA Class B, or better.

11. Cover plates shall be furnished and installed for all electrical outlets, receptacles, switches, etc., to match the material and finish of the equipment to which they will be fastened.
12. Switches, controls, etc., shall be conspicuously labeled as to use with plastic nameplates secured to the adjacent surface as previously specified in Article 2.01-C. Submit a sample for approval if requested by Architect.

13. Where specified for custom fabricated equipment, provide compartment with electrical sub-panel which shall be pre-wired in conduit concealed in cabinet body construction and connected to all electrical components built into or set upon the counter. Electrical sub-panel shall be UL listed, 3-phase, 4-wire circuit breaker type with a ground buss main breaker and individual breakers for each serviced load. Buss shall be copper and the circuit breakers shall be the molded case, bolt-on type with thermomagnetic quick-make, quick-break trip. Multi-pole circuit breakers shall have an internal trip bar. The circuit breakers shall have an interrupting capacity of 10,000 amperes at 120 volts and there shall be a separate breaker for each connected load. Each breaker shall be sized for 125% of the connected load and a minimum of two (2) extra, single pole, 20 amp circuit breakers shall be provided. The loads shall be connected through the breakers in a phased sequence to balance the load on each phase.

B. Water inlets shall be located above the positive water level wherever possible to prevent siphoning of liquids into the water supply system. Wherever conditions shall require a submerged inlet, a suitable type of check valve (except in jurisdictions where check valves are prohibited) and vacuum breaker shall be provided with the fixture to prevent siphoning. Where exposed, piping and fittings shall be chrome-plated. Where vacuum breaker piping is through equipment, provide chrome-plated escutcheon plates to cover holes.

1. KEC to provide and install copper indirect waste lines (insulated from ice bins and ice storage units) from equipment which will discharge into floor drains or safe wastes. Extend to a point at least 1” (or as required by local or state code) above the rim of the floor drain, cut bottom on 45-degree angle and secure in position. CONTRACTOR to coordinate all necessary requirements with the General Contractor.

2. Horizontal piping lines shall be run at the highest possible elevation and not less than 6” above the floor, through equipment where possible.

3. No exposed piping in or around fixtures or in other conspicuous places shall show tool marks or more than one thread at the fitting.

4. Steam operating valves on or in fabricated and purchased foodservice equipment shall be provided with composition hand wheels, which shall remain reasonably cool in service.

5. Provide suitable pressure-reducing valves for equipment with such components that might reasonably be expected to be affected over a period of time by adverse pressure conditions, including but not limited to dishwashers, booster heaters, coffee urns, steam boilers, etc.

C. Provide and install complete refrigeration systems—charged, started, and operating properly—including, but not limited to:

- compressors, condensers, racks, coils, vibration eliminators, sight glasses (moisture indicating type), expansion valves, filters, oil separators, thermostats, defrost time clocks, all controls and control wiring, liquid line driers, piping, and refrigeration grade copper tubing with all sweat joints using Safety-Silv No. 1200 or equivalent silver solder (with as few joints as possible)

1. Where specifications call for pre-piped lines (i.e., from a fixture to a valve compartment, etc.), provide such work in strict conformance with other sections of the specifications.
which set forth standards for this type of work or in conformity with the requirements of the Board of Fire Underwriters or ASHRAE Standards, whichever is the greater.

2. Mechanically refrigerated cold pans shall have a normally closed liquid line electric solenoid valve installed before the expansion valve and wired to a silent-type toggle switch complete with an “on-off” red neon light indicator and both mounted in a terminal box on a removable access panel. This switch shall be fed by a separate control circuit and shall not to be wired into the compressor circuit so that it shall stop the flow of refrigerant to the cold pan and not turn off the compressor. The compressor shall then pump down and turn off through the action of the pressure control.

3. Each refrigeration item specification is written to provide minimum specifications and scope of work. Refrigeration equipment shall be designed and installed to maintain the following general temperatures unless otherwise specified.

<table>
<thead>
<tr>
<th>Refrigeration Item</th>
<th>Temperature</th>
</tr>
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<tbody>
<tr>
<td>a. Walk-In Refrigerators</td>
<td>1.7°C / 35°F</td>
</tr>
<tr>
<td>b. Walk-In Freezers</td>
<td>-23.3°C / -10°F</td>
</tr>
<tr>
<td>c. Reach-In Refrigerators</td>
<td>1.7°C / 35°F</td>
</tr>
<tr>
<td>d. Reach-In Freezers</td>
<td>-23.3°C / -10°F</td>
</tr>
<tr>
<td>e. Undercounter Refrigerators</td>
<td>1.7°C / 35°F</td>
</tr>
<tr>
<td>f. Undercounter Freezers</td>
<td>-23.3°C / -10°F</td>
</tr>
<tr>
<td>g. Cold Pan</td>
<td>-17.8°C / 0°F</td>
</tr>
<tr>
<td>h. Work Rooms</td>
<td>10°C / 50°F</td>
</tr>
</tbody>
</table>

4. Provide electrical and refrigeration components needed by the completed system and complete all connections of and to said components.

5. Provide evaporator coil defrost system on all walk-in refrigerator and freezer rooms where the refrigeration systems are designed to operate at room temperature of less than 35°F.

6. Verify the requirements of and provide any or all additional refrigeration specialty(s) or component(s) required or recommended by the manufacturer for proper operation under the specific operating conditions and location of each system specified.

7. Verify and provide manufacturer’s certification (or certification by manufacturer’s authorized agent) that the equipment selection hereinafter specified for each refrigeration system is properly sized and shall meet the operating requirements set forth for each system regarding maintaining specified operating temperature, hours of compressor running time, and system pressures and velocities as recommended by the equipment manufacturer(s).

8. During check-out and initial operation, make sure that:

   a. Controls are properly adjusted, including refrigeration circuits, room air temperature controls, etc.
   b. Condensers will carry an overload protector.
   c. A competent service mechanic is available during the first eight (8) hours of operation.
   d. Switches, starters, and controls are identified as to function.

9. Unless otherwise specified, thermometers for walk-in units will be furnished with suitable length armored capillary tubes to allow the sensing bulb to be installed in the incoming air
stream to the blower coil with runs fastened to the walk-in walls to prevent it from damage. This identical requirement applies to alarm systems when specified.

2.5 PRODUCT SPECIFICATIONS

A. Refer to Part 4 for complete itemized product specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Begin installing the equipment at the time the building is ready to receive the equipment and in accordance with the schedule.

B. Provide a competent foreman or supervisor for erection of equipment and to coordinate with other trades regarding connections, installation, and inspection. Coordinate delivery schedule to ensure adequate openings in the building to receive the equipment.

C. Refrigeration work shall be accomplished in an approved manner, using first quality fittings, controls, valves, etc. Refrigeration items shall be started up, tested, adjusted, and turned over to the Architect in first-class condition and left operating in accordance with the manufacturer’s specifications.

D. Equipment that rests on masonry bases shall be set level onto a bed of silicone rubber sealant.

E. Equipment that butts to a wall or against other equipment shall be sealed with silicone rubber sealant. Trim strips or other items requiring fasteners shall be set in a bed of silicone rubber sealant and fastened with suitable stainless steel fasteners 48” or less on centers. Prior to the application of sealant, surfaces shall be thoroughly cleaned and degreased.

F. Install and interconnect electrical controls, switches, or other units which are separately furnished for field installation in or on equipment provided, unless otherwise specified.

G. Refrigeration systems shall be installed and wired in strict conformance with the manufacturer’s instructions and recommendations. Ensure that all refrigeration-condensing units are ventilated properly and are accessible for repair, maintenance, and inspection.

H. Hang blower coils per the manufacturer’s recommendation at the locations as shown on the drawings. Unit shall be mounted sloping such that the drain pans are pitched to the drain lines. The coils shall be hung using nylon or other approved non-conductive, non-corrosive fasteners. Coils shall be installed 4” from the interior walk-in ceiling. Furnish #12 gauge galvanized steel fish plates of suitable size and shape on the exterior ceiling of the walk-in to spread the weight of the coils adequately. The coils shall be connected to the condensing unit and the installation shall constitute a complete working system capable of maintaining the interior temperatures specified regardless of the heavy usage the walk-in units may receive.

I. Furnish and install a copper drain line from each coil outlet to a point 1” above the floor drain. Drainlines shall be trapped immediately above the floor drain. The freezer drainline shall be wrapped with a continuous electrified heater tape.
J. Refrigeration tubing shall be the Type L, ACR hard drawn degreased, sealed copper and shall be installed with horizontal runs sloped 1” per 20 feet toward the condensing units. Refrigerant piping shall be properly supported by adjustable hangers spaced and adjusted to the drop required. Where vertical runs of more than 5’ occur in the suction line, the risers shall be trapped at the bottom. Piping is to be installed so that refrigerant or oil cannot drain back into the coils from the suction line.

K. Suction and refrigerant lines shall be insulated with minimum ½” armaplex or equal cellular type insulation. Metal pipe sleeves shall be provided where piping passes through a wall, ceiling, or floor. Space around the tubing shall be filled with mastic insulating compound. Install a permanent suction line filter in each compressor suction line with pressure fitting ahead of the filter to facilitate checking of pressure drop through the filter. Penetrations through walk-in cooler or freezer structures shall be fully insulated and sealed to be vapor tight to prevent condensation within any light fixtures, switch boxes, junction boxes, or any other fittings. Refrigeration and drain lines shall be fully sealed and provided with escutcheon plates by the installer.

L. Furnish and completely install a thermostat to control the refrigeration temperatures for each individual compartment.

M. The condensing units shall be mounted on a welded steel rack. The rack shall contain accessories and components necessary to form a complete condensing unit package. Each condensing unit shall have a factory mounted, pre-wired control panel/disconnect switch complete with circuit breakers, contactors, and time clocks as required.

N. The refrigeration systems shall be furnished with a one-year refrigeration service contract, covering all parts and labor, with service available seven days per week, 24-hours per day. Continuation of the service contract after the first year shall be an option. The refrigeration system shall be warranted for one year and the compressors shall carry the manufacturer’s extended five-year warranty.

O. Furnish four (4) copies of complete remote refrigeration system control wiring and piping diagrams. One (1) copy shall be framed in plexiglass and mounted at compressor location.

P. Coordinate the equipment work with the respective trades so that electrical and mechanical components built into the equipment will conform and/or adapt to the type, materials, and characteristics of the building components.

Q. Install heated and motor-driven equipment so as to operate efficiently. Provide additional vents, guards, deflectors, and other accessories as needed at no additional cost. Note such additions or modifications on the shop drawings and bring to Architect’s attention by special accompanying letter.

3.2 FABRICATION

A. Items of fabricated equipment shall be fabricated in the same factory and shall be similar in construction details, materials, methods, and appearance to similar types of items so fabricated under this contract.
B. Each fabricated item of equipment shall include necessary reinforcing, bracing, and welding with the proper number and spacing of uprights and cross members for strength. Wherever standard sheet sizes will permit, the tops of all tables, shelves, exterior panels of cabinet type fixtures, and doors and drainboards shall be constructed of a single sheet of metal. Except where required to be removable, flat surfaces shall be secured to vertical and horizontal bracing members by welding or other approved means to eliminate buckle, warp, rattle, and wobble. Equipment not braced in a rigid manner and which is subject to rattle and wobble shall be unacceptable, and the Contractor shall add additional bracing in an approved manner to achieve acceptance.

C. Suitable pipe slots shall be provided on fabricated equipment to accommodate service and utility lines and mechanical connections. These slots shall be of proper size and shall be neatly made with turned up edges around to eliminate cutting or defacing of equipment on the job. Cabinet bases shall be provided with an inner panel duct at the ends or rear of the cabinet allowing adequate space to conceal vertical piping. Such work, when performed at the job site, shall be of the same quality as similar work performed in the shop.

D. Exposed surfaces shall be free from bolt and screw heads. When bolts are required, they shall be of the concealed type and be of similar composition as the metal to which they are applied. Where bolt or screw threads on the interior of fixtures are visible or may come into contact with hands or wiping cloths, they shall be capped with a stainless steel acorn nut and stainless steel lock washer.

E. Where screw threads are not visible or readily accessible, they shall be assembled with stainless steel lock washers and nuts. Wherever bolts or screws are welded to the underside of trim or tops, the reverse side of the weld shall be finished uniformly with the adjoining surfaces. Depressions at these points shall not be acceptable.

F. Rivets shall not be permitted in any location.

G. Welding shall be the heliarc method with welding rod of the same composition as the sheets or parts welded. Welds shall be complete, strong, and ductile with excess metal ground off and joints finished smooth to match adjoining surfaces. Welds shall be free of mechanical imperfections such as gas holes, pits, cracks, etc., and shall be continuously welded so that the fixtures shall appear as one piece construction. Butt welds made by spot solder and finished by grinding shall not be acceptable.

1. Spot welds shall have a maximum spacing of 3”. Tack welds shall be of at least ¼” length of welding material at a maximum space of 4” from center to center. Weld spacing at the ends of the channel battens shall not exceed 2” centers.

2. In no case shall soldering be considered as a replacement for welding, nor shall any soldering operation be done where dependence is placed on stability and strength of the joint.

3. Fixtures shall be shop fabricated of one piece and shipped to the job completely assembled wherever possible. Equipment too large to transport or enter the building as one piece shall be constructed so that the field joints can be welded at the job site.

4. Exposed joints shall be ground flush with adjoining material and finished to harmonize therewith. Whenever material has been sunk or depressed by welding operation, such depression shall be suitably hammered and peened flush with the adjoining surface and, if necessary, again ground to eliminate low spots. In all cases, the grain of rough grinding shall be removed by successive fine polishing operations.
5. Unexposed welded joints on undershelves of tables or counters in stainless steel construction shall be suitably coated at the factory with an approved metallic-based paint.

6. After galvanized steel members have been welded, welds and areas where galvanizing has been damaged shall have a zinc dust coating applied in conformance with U.S. Government Military Specification Number MIL-P-26915.

H. Butt joints and contact joints, wherever they occur, shall be close fitting and shall not require a filler. Wherever break bends occur, they shall be free of undue extrudence and shall not be flaky, scaly, or cracked in appearance; where such breaks do mar the uniform surface appearance of the material, such marks shall be removed by suitable grinding, polishing, and finishing. Wherever sheared edges occur, they shall be free of burrs, fins, and irregular projections and be finished to obviate danger of cutting or laceration when the hand is drawn over them. In no case shall overlapping materials be acceptable where miters or bullnosed corners occur.

I. The grain of polishing shall run in the same direction on horizontal and on vertical surfaces of each item of fabricated equipment except in the case where the finish of the horizontal sections of each shall terminate in a mitered edge. Where sinks and adjacent drainboards are equipped with backsplash, the grain of polishing shall be consistent in direction throughout the length of the backsplash and sink compartment.

J. Component parts, whether fabricated by the Contractor or purchased for building into the fabricated equipment, shall conform to the following.

   Bolts, screws, nuts, and washers shall be of steel, except where brass or stainless steel is fastened, in which case they shall be of brass or stainless steel, respectively. Where dissimilar metals are fastened, bolts, screws, nuts, and washers shall be of the higher grade metal. The spacing and extent of bolts and screws shall be such as to ensure suitable fastening and prevent buckling of the metals fastened.

3.3 START-UP AND TESTING

A. Supply a trained person who shall start up equipment, test, and make adjustments as necessary, resulting in each item of equipment performing in accordance with the manufacturer’s specifications.

B. Gas-fired equipment shall be checked by the local gas company as to calibration, air adjustments, etc., and adjustments made as required. Arrange and coordinate such visit.

3.4 CLEAN-UP

A. At completion of the installation, clean up, lubricate, and adjust where necessary items of equipment provided and turn them over in first-class condition.

   1. Where stainless steel surfaces are disturbed by the installation or fabricating process, such surface shall be finished to match adjoining undisturbed surfaces.

   2. At the completion of the installation work, stainless steel shall be gone over with a portable polishing machine and buffed to perfect surfaces. Painted surfaces shall be carefully gone over and retouched as required.
3.5 OPERATION INSTRUCTIONS AND WARRANTIES

A. Arrange for demonstrations and instructions for operating the equipment as requested and at times selected by the Architect. Furnish to the Architect instructions and service manuals for items of equipment that are mechanically operated or that require periodic service. Provide a list of such equipment showing the manufacturer’s warranty for equipment at jobsite location and how warranty service will be provided when necessary.

3.6 SEISMIC RESTRAINTS

A. The Contractor will be required to install items so designated in these contract documents according to the “SMACNA Guidelines for Seismic Restraint of Kitchen Equipment” in any State, province, or jurisdiction that has legislated this requirement as necessary for acceptance.

The Contractor will be responsible for:

1. Identifying these items on his submittal drawings, Plans, Elevations, and Sections.
2. Showing required SMACNA methods of restraint on his submittal drawings.
3. Referencing the appropriate detail(s).

B. If no SMACNA detail exists for a particular situation, the Contractor is responsible for preparing and obtaining approval for a special attachment detail:

1. Detail must be prepared by an engineer licensed by the State having jurisdiction over the project and accompanied by the supporting calculations used in the design.
2. Contractor is responsible for ensuring that the restraint design is appropriate to the building’s structural conditions and the surfaces to which the equipment will be secured.
PART 4 – ITEM SPECIFICATIONS

All items listed on the contract drawings under the heading "Foodservice Equipment Schedule" shall be furnished by the Owner’s kitchen equipment contractor, unless indicated otherwise, in strict accordance with the foregoing specifications and with the following detailed item specifications.

END OF SECTION
SECTION 11 52 13

PROJECTION SCREENS

PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide motor operated, above ceiling mount front projection screen complete with all controls, mounting brackets and hardware.

B. Provide manually operated, wall mount front projection screen complete with all mounting brackets and hardware.

1.02  RELATED SECTIONS

A. Electrical: Division 26. If 2.01.A is selected

1.03  SUBMITTALS

A. Product Data: Submit manufacturer's product data in accordance with the requirements of the General Conditions and Section 01 33 23.

1.04  PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery items in manufacturer's original protective packaging.

B. Store items in original packaging to prevent soiling and physical damage.

C. Handle so as to prevent damage to finished surface.

PART 2  PRODUCTS

2.01  PROJECTION SCREENS

A. Motor Operated Projection Screen

1. Type: Motor operated, remote controlled, recessed ceiling mounted.

2. Screen: Flame retardant and mildew resistant, mat white with black masking borders. Vertical seams permitted at minimum 6' on center. HDTV 16:9 format.

   a. Provide extra drop length of dimension indicated to comply with the following requirements for fabric color and location of drop length:

      1) Color: Black.
      2) Location: At top of screen.
      3) Provide drop length as required for bottom of screen to be set 3' above floor. Coordinate each screen with ceiling/screen mounting height.

   3. Sizes: As indicated on schedule contained herein.
5. Motor: 3-wire quick reversal type; ball bearing with automatic overload cut-off and integral interlocking gears.
   a. Power: 115V, 60 Hz, 3.5 amp.
   b. Controls: Key operated 3-position switch ("UP", "OFF", "DOWN").
   c. Provide with pre-set but accessible limit switches to automatically stop screen fabric in the up and down position. Provide positive stop action.
6. Case: Extruded aluminum back, top and front with stamped steel end caps.
7. Mounting Brackets: Provide ceiling mount type brackets of quantity as required by manufacturer.
8. Manufacturer: Signature Series V Motorized Screen with M1300 Viewing Surface by DRAPER or equal by DA-LITE SCREEN COMPANY, BRETFORD/KNOX MANUFACTURING.

B. Pull Down (Manually Operated) Projection Screens
1. Description: 72" x 72" wall mounted type with heavy gage octagonal steel case with flat back design with baked enamel finish. Provide end caps concealing roller ends and supporting rollers.
2. Fastening system to have plated steel brackets attached to end caps for wall mounting by means of slotted screw holes and ceiling hung by means of plated steel hanger rings.
3. Mount bottom of screen fabric into a metal strip in tubular steel slat finished in baked enamel to match screen housing.
4. Screen: Glass bead surface with masked borders on flame retardant and mildew resistant fabric.
   a. Provide extra drop length of dimension indicated to comply with the following requirements for fabric color and location of drop length:
      1) Color: Black.
      2) Location: At top of screen.
      3) Provide drop length as required for bottom of screen to be set 3’ above floor. Coordinate each screen with ceiling/screen mounting height.
5. Manufacturer: Draper Luma by DRAPER SCREEN COMPANY; DA-LITE SCREEN COMPANY; Knox Series 500 by BRETFORD/KNOX MANUFACTURING COMPANY.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install screens in neat, plumb, true alignment in locations indicated on drawings and as detailed. Comply with written installation instructions of screen manufacturer.

B. Coordinate above ceiling mount with ceiling grid layout.

END OF SECTION
SECTION 11 52 23

TELEVISION MOUNTING BRACKETS

PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide flat screen television wall mount (and ceiling mount where required) type brackets complete with all accessories for mounting at locations indicated on the drawings or specified.

1.02  RELATED SECTIONS

A. Wood Blocking: Section 06 10 00.

1.03  SUBMITTALS

A. Product Data: Submit manufacturer's product data for all items.

1.04  PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver items in manufacturer's original protective packaging.

B. Store items in original packaging to prevent physical damage.

C. Handle so as to prevent damage to finished surface.

PART 2  PRODUCTS

2.01  MANUFACTURERS

A. Specifications are based on mounting brackets manufactured by DRAPER. Catalog numbers are listed to establish a level of quality and performance.

B. Other Manufacturers: Similar models manufactured by BRETFORD MANUFACTURING, LUCASEY, DA-LITE or PEERLESS INDUSTRIES, INC. are acceptable provided the units meet the requirements specified herein.

2.02  MOUNTING BRACKETS

A. Wall Mount Type: DRAPER Model WH T. Fixed height, tilting.

1. Television Size Range: 37” and larger.

2. Double bracket style with universal mounting arms.


4. Tilt mechanism: Steel rectangular tilting frame with 2 steel angles spaced at 16 inches.

a. Equip mechanism with mating bracket to accept keystone plate of monitor bracket.
b. Finish: Matt black, powder coat.

B. Provide all hardware for assembly and attachment of the bracket to various substrates indicated.

C. Coordinate mounting of ceiling units with required overhead mounting steel and brackets.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. In accordance with manufacturer's instructions.

B. Verify that wood blocking has been provided in stud/gypsum board walls; blocking to be located at mounting hardware.

C. Clean-up: Remove all cartons, debris, scraps, etc. and leave spaces clean and have brackets ready to use.

**END OF SECTION**
SECTION 12 22 15
BLACK-OUT DRAPES

PART 1  GENERAL

1.01  WORK INCLUDED
A. Work of this section includes lightproof fabric curtains and ceiling mounted track.

1.02  RELATED WORK SPECIFIED IN OTHER SECTIONS
A. Roller Window Shades:  Section 12 24 23.

1.03  SUBMITTALS
A. Submit manufacturer's product data and full range of color samples.

PART 2  PRODUCTS

2.01  DRAPERIES
A. Fabric:  MAHARAM Design Tex. Actual pattern/color to be selected by Architect. Fabric by Carnegie or Kravet is acceptable provided the color is a match with the selected fabric as approved by the Architect. Color match should be submitted to the Architect during bidding for inclusion by Addendum.

C. Fabric Backing:  Blackout type; 70% polyester/30% cotton; 3-pass 100% blackout; 54" wide.
   1. Flammability : NFPA 701 large scale.
   2. Color:  Ivory or ecru.
   3. Manufacturers:  HANES COMPANIES INC. Outblack 110FR; WESCO FABRICS or ROC-LON.

D. Fabrication: Fabricate all draperies as follows:
   1. Fabrics are to be cut and squared.
   2. Join seams with a serge and sew type of machine with the safety stitch.
   3. Put in heading by completely incasing the four inch permanent stiff crinoline with fabric.
   4. Provide double 4" bottom hem.
   5. Provide double 1-1/4" turn side hems; sew with blind stitch. Put in bottom hem first so that side hem will turn over the bottom hem.
   6. Table draperies to ensure that they are square and of proper dimension
   7. Provide draperies 100% full plus allowance for overlaps, side hems, returns
   8. Press and pleat fold (Decorator fold).
   9. Thread: Color to match drapery fabric. No monofilament thread is to be used except for sewing pleats.
  10. Use covered lead weights at all vertical seams and corners.
2.02 TRACK

A. Type: Surface mounted; one-way, baton draw type. Provide in lengths and shapes required to install at openings indicated. Provide with compatible slide buttons, master carrier and end caps.

B. Material and Finish: Extruded aluminum alloy 6063T5; minimum .070” thick; white finish.

C. Manufacturer: KIRSCH 9046 Series track (#9406 slides, #9644 master carriers and #9682 end caps) or equal by GRABER or LUTRON.

D. Provide ceiling clips, brackets, hooks and hardware.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Install track at location and per layout indicated on drawings or as directed by Associate Architect.

B. Verify that black-out curtain operates smoothly and completely closes off area indicated.

END OF SECTION
SECTION 12 24 13

WINDOW ROLLER SHADES

PART 1  GENERAL

1.01  WORK INCLUDED

A. Work includes: verify shades are located on drawings or include schedule
1. Shade Type 1: Manually operated interior roller-screen solar shades as indicated on the drawings.
2. Shade Type 2: Motor operated interior roller screen solar shades as indicated on the drawings.
3. Shade Type 3: Manually operated, double-shade system, interior roller-screen room darkening and solar shades on same bracket allowing for independent control of each shade as indicated on the drawings.
4. Shade Type 4: Motor operated, double-shade system, interior roller-screen room darkening and solar shades on same bracket allowing for independent control of each shade as indicated on the drawings.
5. Shade Type 5: Motor operated interior roller screen multi-band solar shades as indicated on the drawings.

B. Work also includes furnishing the following for installation by others:
1. Extruded aluminum ceiling pocket trim assemblies for installation under Section 09 51 13 Acoustic Ceiling Systems.
2. Electrical control components including switches, relays, etc as necessary to provide control characteristics as specified elsewhere in this section.

1.02  RELATED SECTIONS

A. Wood Blocking: Section [06 10 00] [06 11 50].
C. Electrical: Division 26.

1.03  PERFORMANCE REQUIREMENTS

A. Fire Test Characteristics: Provide shade fabrics tested in accordance with:

B. Anti-Microbial: Provide shade fabrics tested in accordance with:
1. ASTM G22 – Results for ATCC6538 and ATCC13388 indicating minimum 5mm indicating “No Growth Contact Area”.
2. ASTM G21 – Results for ATCC9642, ATCC9644, ATCC9348 and ATCC9645 indicating “No Growth”.

C. Electrical: Control systems and components approved AS A SYSTEM by either Underwriter Laboratories (UL) or Electrical Testing Laboratories (ETL).
1.04 SUBMITTALS

A. Product Data: Submit manufacturer’s product data sheets, performance data and installation instructions for each item.

B. Shop Drawings
   1. Show location and extent of roller shades.
   2. Include elevations, sections, details and dimensions.
   3. Show installation details, mountings, attachment to other work, operational clearances and relationship to adjoining work.
   4. Complete wiring diagrams including connection details for all components supplied by this section for installation and connection by Division 26.

C. Coordination Drawings: Coordinate with reflected ceiling plans. Show the following:
   1. Ceiling suspension system members and attachment to building structure.
   2. Ceiling mounted or penetrating items.
   3. Shade mounting assembly and attachment.
   4. Size and location of access to shade adjustable components.

D. Samples
   1. Selection Samples
      a. Submit 3” x 5” shade cloth fabric swatches for initial fabric color selection from manufacturer’s full range of available fabrics.
      b. Submit aluminum finish color samples from manufacturer’s full range of colors.
   2. Verification Samples
      a. Submit one fully operational window shade sample of each type required; approximately 30” x 30” complete with selected shade cloth.
      b. One complete set of all shade components, unassembled.

E. Test Reports, Design Data and Certifications: Current reports from independent testing laboratories demonstrating compliance with Article 1.03.

F. Installation Instructions: Submit for types of shades and mounting substrates encountered.

1.05 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer: 20 years minimum experience manufacturing products comparable to those specified.
   2. Installer: 5 years minimum experience installing products comparable to those specified.

B. Do not fabricate shades without obtaining field dimensions for each opening. Coordinate construction of surrounding conditions to allow for timely field dimension verification.

1.06 DELIVERY, STORAGE AND HANDLING

A. Do not deliver shades until painting, wet work, grinding and similar operations
which could damage, soil or deteriorate shades have been completed in installation areas. If, due to unforeseen circumstances, shades must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

B. Deliver shades to project in labeled protective packaging. Label each shade for the appropriate opening. Schedule deliveries to prevent delays to completion of work but to minimize on site storage time.

C. Store shades in a dry secure place. Protect from weather, surface contaminants, corrosion, construction traffic and other potential damage.

1.07 WARRANTY

A. Provide manufacturer’s warranty for the installed systems. Warranty shall provide for repair or replacement of defective roller shade system components, including excessive deterioration or failure of system components. Repair or replacement shall include all costs associated with verifying failures, removal of deteriorated or defective products, replacement, testing, transportation, travel and other expenses related to corrective measures.
    1. Warranty Period: 5 years from date of substantial completion.

B. Shade Motors and motor control system electrical components: Provide Manufacturer’s warranty. Warranty period to be 5 years from Date of Substantial Completion for shade motors and two years for all other control components containing provisions that installation will remain operational without fault for the warranty period and include all operating parts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Drawings and specifications are based on shades manufactured by MECHOSHADE SYSTEMS INC.

B. Other Acceptable Manufacturers: Shades manufactured by LUTRON, DRAPER, SOLARFECTIVE PRODUCTS LIMITED, NYSAN SHADING SYSTEMS are acceptable providing the shade assemblies meet the requirements specified herein and the profile/arrangements indicated on the drawings.

2.02 COMPONENTS

A. Shadebands: Construction of shade bands includes fabric, hembar and hempocket, and the attachment of the shade band to the roller.
    1. Shade Type 1, 2 and 5: Visually transparent single-fabric shade cloth; MECHSHADE ThermoVeil Group, single thickness non-raveling 0.03” thick vinyl fabric, woven from 0.18” extruded vinyl yarn comprised of 21% polyester and 79% reinforced vinyl; colors as selected by Architect.
        a. Dense Basket Weave: 1300 Series, 5% open, 2 x 2 dense basket weave pattern; colors as selected by Architect.
2. **Shade Type 3 and 4:** Double shade system incorporating two independently operable shades on one bracket.
   a. **Solar Shade:** Dense basket weave; 1300 Series, 5% open, 2 x 2 dense basket weave pattern; colors as selected by Architect.
   b. **Black-Out Shade:** ThermoVeil 0700 Series; vinyl coated fabric; colors as selected by Architect.

3. **Hembars and Hempockets:** Fabric hempocket with RF-welded seams (including welded ends) and concealed hem weights. Provide continuous hem weights of appropriate size and weight for shadeband inside sealed hempocket.

B. **Manually Operated Hardware and Shade Brackets:** Shade Types 1 and 3
   1. Provide for regular and offset drive capacity (chain fall at front or rear of bracket) on all shade drive end brackets.
   2. Provide shade hardware system that allows for removal of shade roller tube from brackets without removing hardware from opening.
   3. Provide shade hardware that allows for removal and re-mounting of the shade band without having to remove shade tube, drive or operating support brackets.
   4. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connections are not acceptable.
   5. Provide hardware construction of minimum 1/8” thick cadmium plated steel or heavier as required to support 150% of the full weight of each shade.
   6. **Drive Bracket/Brake Assembly:** Manufacturer’s standard type that disengages to 90% during the raising and lowering of the shade and is capable of withstanding a pull force of 50 pounds in the stopped position.

C. **Motorized Shade Hardware and Shade Brackets:** Shade Types 2, 4 and 5
   1. Provide shade hardware constructed of minimum 1/8” thick (3.175 mm). cadmium plated steel or thicker as required to support 150% of the full weight of each shade.
   2. Provide shade hardware system that allows for removal of shade roller tube from brackets without removing hardware from opening or without requiring end or center support brackets to be removed.
   3. Provide shade hardware that allows for removal and re-mounting of the shade band without having to remove shade tube, or drive or operating or support brackets.
   4. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets regardless of mounting position (inside or outside mount).
   5. Provide shade hardware system that allows for removable regular roll fascia(s) to be mounted continuously across two or more shades without requiring exposed fasteners.
   6. Provide shade hardware system that allows for operation of multiple shadebands offset by a maximum of 12° from the motor axis between shadebands, 6° on each side of the radial line, by a single motor (Multi-banded shades) subject to manufacturer’s design criteria.
   7. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connections for drive mechanism to shade roller tube shall not be accepted.
D. Shade Roller and Shade Cloth Attachment
1. Extruded aluminum; diameter and wall thickness to support shade fabric as determined by manufacturer.
2. Provide for positive mechanical engagement with drive/brake mechanism.
3. Provide for positive mechanical attachment of shade band to roller tube without use of adhesives, adhesive tape, staples or rivets. A mounting method that does not allow the shade band to be removed from the shade tube while installed is not acceptable.
4. Attach shade bands to tube in a manner that allows removal and replacement of the shade band without removing either the tube from the brackets or without removing shade brackets.

E. Drive Chain: #10 Qualified stainless steel chain rated to 90 pound minimum breaking strength.

F. Shade Motors and Motor Control System [IQ/MLC System]: Specifications and Design are based on the IQ/MLC motor control system.
1. Shade Motors
   a. Tubular, asynchronous (non-synchronous) motors with built-in reversible capacitor operating at 110V AC (60hz), single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
   b. Conceal shade motors inside shade roller tube.
   c. Each shade motor draws a maximum current of 2.3 amps.
   d. Use motors rated at the same nominal speed for all shades in the same room.
   e. Total hanging weight of shadeband shall not exceed 80% of the rated lifting capacity of the shade motor and tube assembly.

2. Wall Switches
   a. 3 button architectural flush mounted switches with metal cover plates and no exposed fasteners. Provide keyed type switches where indicated. Key all switches in accordance with Section 08710.
   b. Connect local wall switches to control system components via low voltage (12V DC) 4 conductor modular cable equipped with RJ-11 type connectors supplied, installed and certified under Section 16000.
   c. Connect master wall switches to control system components via low voltage (12V DC) 6 conductor modular cable equipped with RJ-12 type connectors supplied, installed and certified under Section 16000.

3. Motor Control System
   a. Provide power to each shade motor via individual 3 conductor line voltage circuits connecting each motor to the relay based intelligent controllers (IQ/MLC).
   b. Control system components provide appropriate (spike and brown out) over-current protection (+/- 10% of line voltage) for each of the four individual motor circuits and shall be rated by UL or ETL as a recognized component and tested as an integrated system.
   c. Motor control system allows each group of four shade motors in any combination to be controlled by each of four local switch
ports, with up to fourteen possible “sub-group” combinations via local 3 button wall switches and all at once via a master 3 button switch. System shall allow for overlapping switch combinations from 2 or more local switches.

d. Multiple “sub-groups” from different IQ/MLC control components may be combined to form “groups” operated by a single 3 button wall switch, from either the master port or in series from any local switch ports.

e. Each shade motor shall be accessible (for control purposes) from up to four local switches and one master switch.

f. Control system shall allow for automatic alignment of shade hembars at 25%, 50% and 75% of opening heights, or up to three user defined intermediate stopping positions in addition to all up / all down positions regardless of shade height, a total of 5 positions. System shall allow shades to be stopped at any point in the opening height, however, shade hembars may not be in alignment at these non-defined positions. (asynchronous motors)

g. Control system shall have two standard operating modes: Normal Mode allowing the shades to be stopped anywhere in the window’s opening height and Uniform Mode allowing the shades to only be stopped at the predefined intermediate stop positions. Both modes shall allow for all up/all down positioning.

h. Control system components shall allow for interface with low voltage Audio Visual system components via a dry contact terminal block.

i. Control system components shall allow for interface with external analog input control devices such as solar activated controllers, wind activated controllers, 24 hour timers, etc. via a dry contact terminal block.

j. Reconfiguration of switchable groups [as specified in 3.d above] shall not require rewiring of the hardwired line voltage motor power supply wiring or the low voltage control wiring. Reconfiguration of switch groups shall be accomplished within the motor controller device (IQ/MLC).

[F. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.


3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:
a. Individual/Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.

4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.

5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

G. Accessories
1. Provide extruded aluminum pocket closure assemblies for use with drywall or other framed shade pocket construction as indicated on the drawings.
2. Provide extruded aluminum fascia for all shades mounted below the ceiling. Colors as selected by Architect.
3. Black-Out Shades: Designed for eliminating all visible light gaps when shades are fully closed
   a. Side and Sill Channels: Extruded aluminum with light seals; designed to eliminate light gaps at sides and bottom of shades. Finish as selected by Architect.
   b. Shade Band Retention System: Manufacturer’s standard design for guiding shade band material through range of travel and holding shade band flat with edges of material within side channels.

2.03 FABRICATION

A. Fabricate units to completely fill openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise. Comply with manufacturer’s edge clearance standards and recommendations.

B. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8” in either direction per 8’ of shade height due to warp distortion or weave design.

2.04 FINISHES

A. Aluminum Components: Baked enamel; colors as selected by Architect.

B. Steel Components: Baked enamel; colors as selected by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate and conditions for installation. Do no begin installation until conditions are satisfactory. Beginning installation indicates acceptance of site conditions by contractor. Notify Architect upon inspection when the project conditions are unacceptable for shade installation. Beginning of installation means
acceptance of substrate and project conditions.

3.02 INSTALLATION

A. Install units to comply with manufacturer’s instructions for the type of mounting and operation required. Provide units plumb, true and securely anchored in place with recommended hardware and accessories to provide smooth, non-binding operation.

B. Install unit within the following tolerances:
1. Maximum variation of gap at window opening perimeter: ¼” per 8’ (+/- 1/*”) of shade height.
2. Maximum offset from level: 1/16” per 5’ of shade width.

[C. Mounting Conditions in Natatorium: Field verify head conditions and include mounting details with Shop Drawings. Note: Recessed mounting in drywall header/aluminum trim application is not applicable to Natatorium shades.]

3.03 ADJUSTING

A. Adjust drive/brake mechanism for smooth operation. Adjust shade and shade cloth to hang flat without buckling or distortion. Replace units or components that do not hang properly or operate smoothly.

3.04 CLEANING

A. Touch-up damaged finishes and repair minor damage in order to eliminate evidence of repair. Remove and replace work that cannot be repaired to the Architect’s satisfaction.

B. Clean exposed surfaces, including metal and shade cloth, using non-abrasive materials and methods recommended by manufacturer. Remove and replace work that cannot be cleaned to the Architect’s satisfaction.

3.05 DEMONSTRATION

A. Demonstrate operation and instruct Owner’s personnel in the proper operation and maintenance of the shade systems.

END OF SECTION
SECTION 12 46 19

CLOCKS

PART 1  GENERAL

1.01  WORK INCLUDED
  A. Provide room clocks as indicated on drawings.

1.02  SUBMITTALS
  A. Submit manufacturer's product data.

PART 2  PRODUCTS

2.01  ROOM CLOCKS
  A. Description: 14" diameter, surface mount, electric clock.
  B. Electric: 120 VAC.
  C. Finishes
     2. Face: White enamel with black screened numerals.
  D. Model and Manufacturer: Model 500A-2 by PETER PEPPER PRODUCTS, INC. or equal by SETH THOMAS.

PART 3  EXECUTION

3.01  INSTALLATION
  A. Mount clocks at locations and heights indicated on drawings or as directed by Architect.
  B. Make final "plug-in" connection to electric receptacle provided under Division 26.

END OF SECTION
SECTION 12 48 13
ENTRANCE MATS

PART 1 GENERAL

1.01 WORK INCLUDED
   A. Provide surface applied entrance mat in vestibules as indicated.

1.02 SUBMITTALS
   A. Submit shop drawings and product data.
   B. Selection Samples: Submit actual samples of mat illustrating manufacturer’s full range of colors.
   C. Verification Samples: After color selection has been made by the Architect, submit two samples 8” x 8”, illustrating color, finish and edging on two sides.

1.03 DELIVERY, STORAGE AND HANDLING
   A. Deliver, store and handle mats in accordance with mat manufacturer’s instructions.
   B. Inspect products upon delivery and record defects. Reroll for storage yarn side out on carpet cores and lay flat; do not fold or crease mats.
   C. Store in dry location and protect from freezing temperatures. Do not place other objects on top of stored mats.

PART 2 PRODUCTS

2.01 ENTRANCE MATS
   A. Description: Polypropylene surface yarn with rubber or PVC backing; designed to hold water for extraction.
      1. Surface Yarn: 100% polypropylene ribbed needlepunch, solution dyed and UV stabilized.
         a. Face Weight: 24 oz/sq. yd.
      2. Backing: Rubber or PVC, anti-microbial; designed to adhere directly to concrete slab.
      3. Edging: Rubber or PVC.
      4. Pile Height: ¼”
   B. Size and Shape: As indicated on Drawings. Field verify exact size of vestibule areas.
   C. Color: As selected by Architect.
D. Manufacturer
1. Basis of Design: Waterhog Classic by THE ANDERSEN COMPANY.
2. Other Manufacturers: Subject to requirements, products by SBEMCO INTERNATIONAL, INC. or CONSTRUCTION SPECIALTIES, INC. are acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with shop drawings and manufacturer's instructions.

B. Verify that substrate is free of indentations, protrusions and other surface defects or coatings that would interfere with a proper installation.

END OF SECTION
SECTION 21 10 00

FIRE PROTECTION

PART 1 GENERAL

1.01 PROJECT SUMMARY

A. Work in this Section includes, but is not necessarily limited to providing all engineering and associated costs, calculations, labor, materials, supervision, testing, permits and approvals required to design, install and obtain final acceptance of the automatic fire protection sprinkler system complete in all respects.

B. The fire protection system shall provide full and complete coverage of all areas, and shall be compatible with the contract document layouts and avoid interference with work of all other trades in the building. Contractor shall provide offsets as needed to avoid other trades, including but not limited to mechanical ductwork, hydronic piping, structural elements and lighting.

C. Provide fire protection system complete with all component equipment and material items. Install and test in full conformity with the requirements of all applicable codes, National Fire Protection Association (NFPA) 13-2012 Edition.

1.02 DEFINITIONS

A. Working Plans: Documents, including shop drawings, calculations, and material specifications prepared according to NFPA 13, 14, and 24 for obtaining approval from authorities having jurisdiction.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

A. Sprinkler systems shall not be calculated to less than 5 psi or 10% below the actual water supply available, whichever is greater. Sprinkler plans and calculations must take into account and show elevation loss from the flow test location to the flowing sprinklers. Flow test information must be recent to within one (1) year previous to submittal of sprinkler drawings.

B. NFPA standards require that the spray deflector of the sprinkler heads be installed eighteen (18") inches minimum above the top of the shelves.

C. Sprinkler deflectors shall be positioned to avoid obstruction to both activation and discharge. Obstructions are (but are not limited to) lights, diffusers, duct-work, structural members (false or real), displayed signage or any object capable of impeding the proper activation and discharge of the fire sprinklers. Installation shall comply to the referenced NFPA 13 document (Chapter 4) and the manufacturers listing. The sprinkler contractor shall be responsible for final coordination.
D. All obstructions exceeding four (4') feet wide or which cannot be spaced around (to comply with 1.4.F) shall have sprinklers installed beneath the obstruction. If sprinklers are installed at or below 7'.6" they shall be equipped with a listed head guard.

E. All sprinkler heads in finished ceilings shall be symmetrically spaced to provide proper coverage, and to avoid interference with lights, diffusers, grilles, or other ceiling mounted equipment. The head layout shall conform to the typical pattern and centered in any ceiling tile or similar feature.

F. All overhead piping located in areas containing ceilings shall run concealed above the ceiling, without exception.

G. Consult the bid specification drawings for acceptable locations for all piping to be run exposed (areas without ceilings).

H. Inspector's tests to be provided with half-inch orifice, discharging at three (3") inches above a hard paved surface. Provide pressure relief valves at inspectors test locations on all "grid" type systems. All inspector's test shall not be located behind racking or other obstructions, and shall be located within eighteen (18") inches of an exterior door opening.

I. Provide flushing and drainage as per required in NFPA 13.

J. System control valves accessed from the interior of the riser area and shall be tampered butterfly valves.

K. Provide sprinkler protection at electrical rooms per the requirements of the local jurisdiction.

L. The calculations shall include all sprinklers within the most hydraulically demanding area along each branch line within the distance determined using a 1.2 multiplier (times the square feet of the area).

M. The contractor shall provide a valve connection discharging onto a paved (outside) surface, to allow full system demand to flow forward of the backflow preventor for testing. The test connection shall be capable of full system flow and shall not require system drainage or alteration. Note, the two (2") inch main drain and FDC are not acceptable.

**PART 2  PRODUCTS**

2.01 GENERAL PARAMETERS

A. All materials submitted and installed shall be UL listed, individually or as any assembly to be installed in a fire protection system.

B. All materials shall be acceptable to all national and local applicable codes and standards.
2.02 SPRINKLER HEADS

A. No sprinklers to be installed are permitted to have a rubber O-ring seal. Only metallic "spring seal" or equivalent seals are allowed.

B. All sprinkler types and temperature ratings shall be as indicated on the drawings.

2.03 BRACKETS

A. Brackets for attaching pipe hangers to building structure shall be the size and type for the intended use, and acceptable to the structural engineer in accordance with NFPA 13.

2.04 SWITCHES

A. Provide all tamper and flow switches for indicating control valves and systems and as required by local ordinances.

2.05 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Specialty Valves and Devices:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.

2. Water-Flow Indicators and Supervisory Switches:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.

3. Sprinkler, Drain and Alarm Test Fittings:
   a. Central Sprinkler Corp.
   b. Grinnell Corp.
   c. Victaulic Co. of America

4. Sprinkler, Branch-line Test Fittings:
   b. Fire-End and Croker Corp.

5. Sprinkler, Inspector's Test Fittings:
   a. Fire-End and Croker Corp.
   b. G/J Innovations, Inc.
   c. Triple R. Specialty of Ajax, Inc.

6. Fire Department Connections:
   a. Grinnell Corp.
   b. Guardian Fire Equipment, Inc.
7. Sprinklers:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.

8. Indicator Posts and Indicator-Post, Gate Valves:
   b. Grinnell Corp.
   c. Nibco, Inc.

9. Indicator Valves:
   a. Grinnell Corp.
   b. Nibco, Inc.
   c. Victaulic Co. of America

10. Fire Protection-Service Valves:
    a. Grinnell Corp.
    b. Nibco, Inc.
    c. Victaulic Co., of America

11. Grooved Couplings for Steel Pipe
    a. Grinnell Corp.
    b. National Fittings, Inc.
    c. Victaulic Co. of America

2.06 PIPE AND FITTINGS

A. Ductile-Iron Pipe: AWWA C151, push-on-joint type, with cement-mortar lining and seal coat according to AWWA C104. Include rubber gasket according to AWWA C111.

B. Ductile-Iron Pipe: AWWA C151, mechanical-joint type; with cement-mortar lining and seal coat according to AWWA C104. Include glad, rubber according to NFPA 1963 and matching local fire department sizes and threads, and bottom outlet with pipe threads. Include brass, lugged caps, gaskets, and brass chains; brass, lugged swivel connection and drop clapper for each hose-connection inlet; eighteen (18") inch (460-mm) high brass sleeve; and round, floor, brass, escutcheon plate with marking "AUTO SPKR."
   2. Finish Including Sleeve: Rough chrome-plated.

C. Other Pipe: ASTM A795, Sch 40 Steel Pipe (or Sch 10 where allowed by NFPA 13).

2.07 PRESSURE GAUGES

A. Pressure Gauges: UL 393, 3 ½ to 4 ½ inch - )90 to 115 mm) diameter dial with dial range of 0 to 300 psig.
PART 3  EXECUTION

3.01 INSTALLATION

A. Furnish and install under this Section all hangers and steel fabrications, other than building structure, required for proper support of piping and equipment.

3.02 IDENTIFICATION

A. Identify exposed or accessible piping with snap-on or strap-on type markers. Color or markers shall be red for all fire protection service. Indicate pipe contents and direction of flow on marker. Install markers on piping not more than 20 feet apart, at valves, at access panels and at least once above each space.

3.03 HANGER ATTACHMENTS

A. Support of pipes with diameter larger than 2 ½ inches may require modification of structural members to support increased loads. Suspend piping and equipment supported by building structure only by those methods, and only at those locations acceptable to the structural engineer.

B. Provide supplementary supporting steel fabrication to bridge between structural steel fabrication to bridge between structural members to receive the hanger. Attach supplementary members to building structure only by those methods, and at those locations acceptable to the structural engineer.

3.04 INSPECTION, TESTING, AND CLEANING

A. Arrange for all inspections, examinations and tests in full conformity with the requirements of all applicable codes, National Fire Protection Association (NFPA) standards and authority having jurisdiction necessary to obtain complete and final acceptance of the fire sprinkler system.

B. Flush underground piping and pressure test at 200 psi for two (2) hours prior to connection to overhead piping. Flushing and testing shall be witnessed by the Fire Department.

C. Leave entire sprinkler system clean in every respect at the conclusion of the work.

D. Testing will occur after installation of all systems has been completed (approximately two (2) to three (3) weeks prior to opening). The contractor shall be required to provide a lift, air, and water pumps for system pressurization, and any necessary hand tools and apparatus for complete testing and draining of the systems. One (1) test of all systems should be completed within one (1) day. If all or any systems fail, the contractor shall be responsible to be present and furnish all items listed.
above until such time that systems are found to be acceptable or in accordance with NFPA 13, 25, and the bid documents. The contractor is responsible for notifying the Owner when installation is complete and testing may begin. Please allow five (5) to ten (10) working days for scheduling.

E. The contractor shall furnish to the owner a complete set of signed and witnessed test certificates for the following:
   1. Underground flushing.
   2. Underground hydrostatic test.
   3. Interior wet system hydrostatic test(s).
   4. All system trip tests.

F. The Contractor shall train owner on use of all equipment and furnish two (2) copies to be left on site, of NFPA 25 the latest edition, and all apparatus manuals, please allow seven (7) days for scheduling.

3.05 WARRANTY

A. Provide warranty in accordance with the General Conditions for a period of at least one (1) year.

END OF SECTION
PART 1  GENERAL

1.01 QUALITY ASSURANCE

A. Conform to the following:
   1. International Plumbing Code – 2012

1.02 STANDARDS

A. Comply with all pertinent standards.
   1. AWS: American Welding Society.
   2. ASME: American Society for Mechanical Engineers.
   3. MSS: Manufacturer’s Standard Society.

1.03 SUBMITTALS

A. Submit under provisions of Division 01.
   1. Submit complete descriptions, specification data for material and equipment proposed. Clearly indicate proposed items when other items are shown on same sheet.
   2. Submittals in 3-ring binders shall include an index of contents and divider tabs.
   3. Shop Drawings:
      a. Plumbing Fixtures and Hardware
      b. Piping Systems
      c. Valves
      d. Insulation
      e. Pumps
      f. Water Heaters
      g. Plumbing Specialties

1.04 REGULATORY REQUIREMENTS

A. Perform Work specified in Division 22 in accordance with 2012 IPC and by the authority having jurisdiction.

1.05 PROJECT/SITE CONDITIONS

A. Layouts indicated on drawings are diagrammatical and intended to show relative positions and arrangement of equipment and piping. Coordinate plumbing work with other trades and measurements obtained at the job site, as applicable, prior to installation. Generally, install work in locations shown on Drawings, using as necessary, rises, drops, offsets, and alternate routings to fit in the available space unless prevented by Project
1.06 COMPLETENESS OF WORK

A. The Contract Documents depict plumbing systems which are intended to be complete and functioning systems. All products, materials, and labor necessary to render a fully functional system to fulfill the design intent shown on the documents shall be provided by the Contractor.

B. Model numbers referenced throughout the Division 22 Drawings and Specifications are intended to convey a general understanding of the type and quality of the product required. Where written descriptions differ from information conveyed by a model number, the written description shall govern. No extra shall be allowed because a model number is found to be incomplete or obsolete.

1.07 RECORD DRAWINGS

A. Provide record drawings that illustrate the work of Division 22 as finally constructed. Provide dimensions of material installed below slab/grade from fixed and visible reference points. Deliver record drawings to the architect in a form suitable for production.

B. Record drawings shall reflect all changes made to the Contract Documents, whether generated by addenda, change orders, or field conditions. Maintain a daily record of these changes and keep current set of drawings showing these changes.

C. Deliver record drawings to Architect within 30 days of Substantial Completion.

1.08 OWNER AND OPERATING MANUALS

A. Comply with the requirements of Division 01, but provide a minimum of three sets, in three ring binders, all sets identical.

B. Manuals shall include clear and comprehensive operating instructions with appropriate graphics and project specific marked data to enable owner to operate and maintain all systems specified in this Division.

C. Copies of approved submittals on furnished equipment shall be included.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 EXCAVATING AND BACKFILLING

A. Provide trenching, excavating, and backfilling necessary for performance of plumbing work in accordance with Division 02.
3.02 CUTTING AND PATCHING
A. Repair or replace damage caused by cutting or installation of work specified in Division 22.
B. Perform repairs with materials which match existing and install in accordance with the appropriate section of these specifications.
C. Correct unnecessary damage caused due to the installation of plumbing work.

3.03 FLASHING AND COUNTERFLASHING
A. Counterflash pipes where penetration of roofs and outside walls occur.

3.04 DELIVERY, STORAGE, AND PROTECTION
A. Insofar as possible, deliver items in manufacturer's original unopened packaging. Where deliver in original packaging is not practical, provide cover and shielding for all items with protective materials to keep them from being damaged. Use care in loading, transporting, unloading, and storing to keep items from being damaged.
B. Store items in a clean, dry place, and protect from damage. Mechanical equipment may not be staged or stored outdoors unless intended for outdoor use. Do not install damaged or wet insulation; Remove from site.
C. Protect nameplates on motors, pumps, and similar equipment. Do not paint or insulate over nameplate data.
D. Protect valves and piping from damage. Cover equipment during work of finishing trades.
E. Keep dirt and debris out of pipes.
F. Repair, restore, and replace damaged items.
G. Cover factory finished equipment during work of finished trades, such plumbing fixtures and water heaters.

3.05 SLEEVES
A. Floors: Sleeve all pipe penetrations. Extend sleeve 1-1/2" above finished floor, except piping within pipe chases. Sleeve shall be flush with underside of floor.
B. Masonry or concrete walls: Sleeve all pipe penetrations. Sleeves shall be flush on both sides of wall.
C. Drywall partitions: Sleeve all penetration of piping in systems over 160 degree F.

D. Seal voids between outside surface of sleeve and wall, partition or floor. Seals shall be airtight.

E. Install piping, insulation and sleeves in strict accordance with applicable U.L. floor or partition assembly instructions. Coordinate with Division 07 firestop manufacturer's installation instructions.

F. Penetrations not sleeved or firestopped:
   1. Seal voids between pipe and partition. Seals shall be airtight.

3.06 ESCUTCHEON PLATES

A. Provide chromium plates escutcheon plates for exposed uninsulated pipes projecting through floors or walls in "finished" spaces. Mechanical rooms, store rooms, electric closets, and janitor closets are not considered "finished" spaces.

B. Clearance between sleeve and pipe: Minimum of 1/2 inch for hot piping and 1 inch for cold piping or as otherwise dictated by U.L. Fire Resistance Directory.

3.07 TESTING

A. Test all installed equipment and systems and demonstrate proper operation. Correct and retest work found defective when tested.

B. Thoroughly check piping system for leaks. Do not add any leak-stop compounds to the system. Make repairs to piping system with new materials. Peening, doping, or caulking of joints or holes is not acceptable.

C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at a water pressure of 125 psig for two hours without leaks.

D. Test drainage and venting system with necessary openings plugged to permit system to be filled with water and subjected to a minimum water pressure of 10 feet head at top of system. System to hold water for two hours without a water level drop greater than 4" in a 4" standpipe and without visible leakage. Test system in sections if minimum head can be maintained in each section.

E. Conduct air or smoke test if in opinion of Designer reasonable cause exists to suspect leakage or low quality workmanship.

F. Test flush valves for proper operation.

END OF SECTION
SECTION 22 05 53

IDENTIFICATION OF PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL (NOT USED)

PART 2 PRODUCTS

2.01 NAMEPLATES AND TAGS

A. Acceptable manufacturers: Seton Nameplate or Brady.

B. Rigid plastic, "Setonite" or bakelite with engraved lettering, minimum 1/2" high.

C. Brass tags, at least 1-1/2" inches in diameter, with alpha-numeric I.D., permanently stamped black filled letters showing the service, and black filled numbers showing the equipment number. At substantial completion, a schedule of all valves shall be submitted to the Architect and Owner's Representative.

2.02 PIPE MARKERS

A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, pre-formed to fit around pipe or pipe covering.

2.03 PIPE IDENTIFICATION

A. Pipe Identification:
   1. Identify piping by snap-on or strap-on labels (to denote contents and direction of flow) on piping at no more than 20 foot intervals at valves, and at least once in each separate space through which the pipe passes.
   2. Identification includes domestic cold water; hot water; recirculation hot water; rainwater; storm; waste; gas.
   3. All piping in mechanical rooms shall be labeled to identify contents and direction of flow.

2.04 EQUIPMENT AND APPARATUS IDENTIFICATION

A. Acceptable Manufacturers: Seton Name Plate Corporation or equal.

B. Nameplates: Rigid plastic, "Setonite", Seton or Brady with engraved lettering (indicating names and numbers of mechanical apparatus), a minimum of 1/2" high. Fill engraved lettering with a permanent coloring material which contrasts with color of tag material to allow for easy reading.

C. Use names, numbers, and abbreviations appearing in schedules on Contract Drawings.
D. Provide nameplates, located in a conspicuous location directly on the equipment or apparatus, for mechanical equipment including, but not limited to:
   1. Water heaters
   2. Pumps
   3. Plumbing equipment

E. Name tag Fasteners: Commercial quality, rust resisting nuts and bolts with backwashers, self-tapping screws, or rivets. If equipment surface does not allow for direct attachment, use copper or brass rings to attach tags.

**PART 3  EXECUTION**

3.01 INSTALLATION

A. Install pipe identification markers per manufacturer's installation instructions.

B. Install equipment nameplates per manufacturer's installation instructions.

**END OF SECTION**
SECTION 22 07 19

PLUMBING INSULATION

PART 1  GENERAL

1.01  QUALITY ASSURANCE

A.  Flame/Smoke Ratings:  Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 method.

1.02  EXISTING SERVICES

A.  Maintain existing services in operation during construction.  Coordinate and schedule all service interruptions with Owner.

PART 2  PRODUCTS

2.01  ACCEPTABLE MANUFACTURERS:

A.  Available Manufacturers:  Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

   Johns Manville Corp.
   Owens-Corning Fiberglas Corp.
   Rubatex Corp.

2.02  PIPING INSULATION MATERIALS:

A.  Fiberglass Piping Insulation:  ASTM C 547, Type 1 unless otherwise indicated.

B.  Flexible Unicellular Piping Insulation:  ASTM C 534, Type I (Tubular).

C.  Jackets for Piping Insulation:  ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient.  Type I may be used for all piping at Installers option.
   1. Encase pipe fittings, valves, strainers, etc. with insulation with glass fabric and vapor barrier mastic applied as per manufacturer's recommendations.

D.  Encase the following with 0.016" smooth aluminum jacket, secured with sheet metal screws and 1/4-inch aluminum bands.  Fittings shall be covered with factory-formed aluminum elbow covers.
   1. All interior piping insulation within 7'-0" of floors or work surfaces.
   2. All valves, fittings, etc. within 7'-0" of floors or work surfaces.
   3. All fittings within 7'-0" of floors or work surfaces to be covered with factory formed aluminum elbow covers.
E. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

F. Tees and elbows for insulated piping shall be factory premolded insulation fittings, similar to that manufactured by Hamfab.

G. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.03 EQUIPMENT INSULATION MATERIALS:

A. Flexible Unicellular Equipment Insulation: ASTM C 534, Type II.

B. Jacketing Material for Equipment Insulation: Provide metal jacket, except as otherwise indicated.

C. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

D. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PLUMBING PIPING SYSTEM INSULATION:

A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow regulators, drain lines from water coolers, and pre-insulated equipment.

B. Cold Piping:
   1. Application Requirements: Insulate all cold plumbing piping systems, which include the following:
      a. Potable cold water piping.
      b. Horizontal interior above-ground storm and rain water piping.
      c. Condensate piping.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation with a thermal conductivity of 0.24 to 0.28 BTU · in/(h · ft · 0°F):
      a. Fiberglass: 1/2” thickness for cold water.
      b. Fiberglass: 1” thickness for storm /rain water.
      c. Fiberglass: 1/2” thickness for condensate piping.

C. Hot Piping:
1. Application Requirements: Insulate all hot plumbing piping systems, which include the following:
   a. Potable hot water piping.
   b. Potable hot water recirculating piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation with a thermal conductivity of 0.24 to 0.28 BTU ·in/(h · ft 2 · 0°F):
   a. Fiberglass: 1" thick for potable hot water supply.
   b. Fiberglass: 1" thick for recirculating hot water piping.

D. Glass fiber blanket inserts with PVC covers are not acceptable for pipe fitting insulation.

E. Hangers:
   1. All hanger nuts to be tighten AFTER insulation is added to the piping.
   2. All metal shields should be installed BEFORE nuts are tightened.
      Minimum shield length shall be 12". Provide a section of Foamglass insulation between pipe and metal shield to prevent crushing of insulation. All shields shall be 14 gauge.

F. Protection
   1. All damaged insulation caused by maintenance or construction shall be replaced by contractor, up to and through the completion of the Punch List.

3.03 INSTALLATION OF PIPING INSULATION:

A. Use glass fiber sectional pipe insulation for domestic water piping. Glass fiber factory premolded fitting matching basic insulation equivalent to that manufactured by Hamfab shall be provided at all pipe fittings (Tees and ells) and finished with glass fabric and vapor barrier mastic. Glass fiber blanket inserts with PVC covers are not acceptable for pipe fitting insulation.

B. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

C. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

E. Clean and dry pipe surfaces prior to insulating. All butt-joints for cold water or condensate drain lines must be glued securely any openings to prevent the build-up of condensation.

F. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Repair any insulation jacket damaged so it has permanent seal. Cover all joints, rips, tears punctures, staples, insulpins or breaks in vapor barrier jacket with 4" wide woven glass fabric embedded in vapor barrier fire resistant mastic.
G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.

H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

I. For hot pipes, apply 3” wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3” wide vapor barrier tape or band. Piping insulation to continue through 100% of pipe hangers. No insulation shall be cut where a hanger is located for any loop water, cold water or condensate drain lines.

J. Insulate all domestic water valves that could condensate and drip.

K. For any service when above grade, exposed to weather outside building, and exposed in equipment rooms to within 7 feet above floors, cover pipe insulation with 0.016” thick smooth aluminum jacket equivalent to Childers and cover valves and fittings with .024” thick aluminum factory formed covers equivalent to Childers E11-Jacs.

3.04 INSTALLATION OF EQUIPMENT INSULATION:

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

E. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

F. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2”. Apply over vapor barrier where applicable.

G. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

H. Hangers:
   1. All hanger nuts to be tighten AFTER insulation is added to the equipment
   2. All metal shields to be installed BEFORE nuts are tightened.
I. Protection

1. If equipment will be walked on to do further maintenance or construction work then the insulation will be replaced by contractor, up to and through the completion of the punch list.

2. If equipment that is insulated may need to be walked on for the long-term maintenance of the building, proper shields will be provided at traffic ways that cross the piping.

3.05 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION
SECTION 22 10 05

PLUMBING PIPING & VALVES

PART 1  GENERAL

1.01 REFERENCES

A. Submit pipes, valves and fittings and have approval prior to starting construction. Pipe, valves and fittings shall be new and clearly marked with manufacturer’s name, classification and working pressure.

PART 2  PRODUCTS

2.01 SANITARY SEWER PIPING, BURIED

A. PVC Pipe: ASTM D 2665 or ASTM D 3034.
   1. Fittings: PVC.

2.02 SANITARY SEWER AND CONDENSATE PIPING, ABOVE GRADE

A. Sanitary Sewer - Cast Iron Pipe: CISPI 301, hubless service weight.
   1. Fittings: DWV Cast Iron.

B. Condensate Piping - Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2.03 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B 42, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2.04 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2.05 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.06 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping - Drain, Waste, and Vent:

2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

B. Plumbing Piping - Water:

2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
7. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.07 BALL VALVES

A. Construction, under 2 Inches: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, stainless steel brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, threaded ends with union. Nibco TS 585 or approved equal.
2.08 AIR VENTING
A. Provide manually operated air vents at high points in vertical risers to eliminate air from systems.
B. Use ball valves for manual air vents.

2.09 ESCUTCHEONS
A. Provide chrome plated escutcheons where insulated pipes penetrate walls or ceilings of finished spaces.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION
A. Ream pipe and tube ends. Remove burrs.
B. Remove scale and dirt, on inside and outside, before assembly.
C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION
A. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Install piping free of sags and bends. Group piping whenever practical at common elevations.
B. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
C. Do not use bullhead tees.
D. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
E. Install fittings for changes in direction and branch connections.
F. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

J. Provide access where valves and fittings are not exposed. Install piping to permit servicing.

K. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

N. Install bell and spigot pipe with bell end upstream.

O. Install valves with stems upright or horizontal, not inverted.

P. Install water piping to ASME B31.9.

3.04 SLEEVES AND INSERT

A. Sleeve pipes passing through partitions, walls and floors.

B. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.05 PIPE HANGERS AND SUPPORTS:

A. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation.

3.06 APPLICATION
A. Install unions downstream of valves and at equipment or apparatus connections.
B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.07 ERECTION TOLERANCES
A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope.
B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.08 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM
A. Disinfect water distribution system.
B. Prior to starting work, verify system is complete, flushed and clean.
C. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
F. Maintain disinfectant in system for 24 hours.
G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
I. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.09 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe size: 1/2 inches to 1-1/4 inches:
         1) Maximum hanger spacing: 6.5 ft.
         2) Hanger rod diameter: 3/8 inches.
      b. Pipe size: 1-1/2 inches to 2 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 3/8 inch.
      c. Pipe size: 2-1/2 inches to 3 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 1/2 inch.
      d. Pipe size: 3 inches to 4 inches:
         1) Maximum hanger spacing: 12 ft.
         2) Hanger rod diameter: 1/2 inch.

END OF SECTION
SECTION 22 10 06

PLUMBING PIPING SPECIALTIES

PART 1 GENERAL (NOT USED)

PART 2 PRODUCTS

2.01 WATER HAMMER ARRESTORS

A. Water Hammer Arrestors:
   1. Copper construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range 34 to 250 degrees F (1 to 120 degrees C) and maximum 150 psi (1000 kPa) working pressure.

2.02 MIXING VALVES

A. Thermostatic Mixing Valves:
   1. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
   2. Accessories:
      a. Check valve on inlets.
      b. Volume control shut-off valve on outlet.
      c. Stem thermometer on outlet.
      d. Strainer stop checks on inlets.
   3. Cabinet: 16 gage enameled steel, for surface mounting with keyed lock.

2.03 BALANCING VALVES

A. Memory-Stop Balancing Valves
   2. Pressure Rating: 400-psig minimum CWP.
   3. Size: NPS 2 or smaller.
   4. Body: Copper alloy.
   5. Port: Standard or full port.
   7. Seats and Seals: Replaceable.
   8. End Connections: Solder joint or threaded.

2.04 WALL HYDRANTS

A. Nonfreeze Wall Hydrants
   3. Operation: Loose key.
   4. Casing and Operating Rod: Of length required to match wall...
thickness. Include wall clamp.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Chrome plated.
11. Operating Key(s): One with each wall hydrant.

2.05 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.06 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves
2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
8. Inlet: Threaded or solder joint.

2.8 CLEANOUTS

A. Cleanouts at Exterior Surfaced Areas
1. Round cast nickel bronze access frame and non-skid cover.

B. Cleanouts at Exterior Unsurfaced Areas
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

C. Cleanouts at Interior Finished Floor Areas
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept
floor finish in finished floor areas.

D. Cleanouts at Interior Finished Wall Areas
   1. Line type with lacquered cast iron body and round epoxy coated
gasketed cover, and round stainless steel access cover secured
   with machine screw.

E. Cleanouts at Interior Unfinished Accessible Areas Caulked or threaded
type.
   1. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded
   cleanout plugs with mixture of graphite and linseed oil. Ensure clearance
   at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines
   where contamination of domestic water may occur; on boiler feed water
   lines, janitor rooms, premise isolation, irrigation systems, flush valves,
   interior and exterior hose bibs.

F. Pipe relief through fixed airgap and discharge to sewer.

G. Install water hammer arrestors complete with accessible isolation valve
   on hot and cold water risers and supply piping to lavatories.

H. Install supply type, trap-seal primer valves with outlet piping pitches down
   toward drain trap at a minimum of 1 percent, and connect to floor drain
   body, trap or inlet fitting. Adjust valve for proper flow.

END OF SECTION
SECTION 23 05 00

GENERAL PROVISION FOR HVAC

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Conform to the following:
   2. International Mechanical Code – 2012

1.02 STANDARDS

A. Comply with all pertinent standards.
   1. AMCA: Air Moving and Conditioning Association
   3. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.
   4. ASME: American Society for Mechanical Engineers.
   5. NEMA: National Electrical Manufacturer's Association.
   7. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
   8. UL: Underwriters' Laboratories, Inc.

1.03 SUBMITTALS

A. Submit under provisions of Division 01.
   1. Submit complete descriptions, specification data for material and equipment proposed. Clearly indicate proposed items when other items are shown on same sheet.
   2. Submittals in 3-ring binders shall include an index of contents and divider tabs.
   3. Shop Drawings:
      a. Control System
      b. Air Handling Equipment
      c. Air Terminal Units
      d. Fan Coil Units
      e. Air Distribution, Ductwork, Grilles, Registers
      f. Insulation
      g. Filters
      h. Vibration Isolation
      i. Boilers
      j. Chillers
      k. Pumps and Hydronic Specialties
      l. Sound attenuators
      m. Steam/Hot Water Heat Exchanger
ADHESIVES AND SEALANTS

A. Adhesives, sealants, and sealant primers used inside the building (defined as inside the weatherproofing envelope and applied on site) shall comply with SCAQMD Rule 1168-2005 for volatile organic compound content limits.

B. Aerosol adhesives shall comply with GS 36-2011 for volatile organic compound content limits.

REGULATORY REQUIREMENTS

A. Perform Work specified in Division 23 in accordance with standards listed below of the latest applicable edition adopted by the authority having jurisdiction. Where these Specifications are more stringent, they shall take precedence. In case of conflict, obtain a decision from the Architect.

3. ANSI Handicapped Code-A117.1
4. IBC: International Building Code, with Mechanical and Plumbing Codes.
5. Special regulations, supplement, and amendments of the State and/or local authorities having jurisdiction.

B. Comply with the applicable edition date of each regulation as adopted by the authorities having jurisdiction.

CONTINUITY OF EXISTING SERVICE AND SYSTEMS

A. Schedule work so existing systems will not be interrupted when they are required for normal usage of the existing building. Obtain approval from the Owner and Architect at least 7 days prior to any utility interruption or connection.

B. Perform work at such time and in such manner as to cause minimum inconvenience to the Owner and as approved by the Architect. No allowance will be made for lack of knowledge of existing conditions.

PROJECT/SITE CONDITIONS

A. Layouts indicated on drawings are diagrammatical and intended to show relative positions and arrangement of equipment, ductwork and piping. Coordinate mechanical work with other trades and measurements obtained at the job site, as applicable, prior to installation. Generally,
install work in locations shown on Drawings, using as necessary, rises, drops, offsets, transitions, and alternate routings to fit in the available space unless prevented by Project conditions.

1.08 COMPLETENESS OF WORK

A. The Contract Documents depict HVAC systems which are intended to be complete and functioning systems. All products, materials, and labor necessary to render a fully functional system to fulfill the design intent shown on the documents shall be provided by the Contractor.

B. Catalog numbers referenced throughout the Division 23 Drawings and Specifications are intended to convey a general understanding of the type and quality of the product required. Where written descriptions differ from information conveyed by a catalog number, the written description shall govern. No extra shall be allowed because a catalog number is found to be incomplete or obsolete.

1.09 RECORD DRAWINGS

A. Provide record drawings that illustrate the work of Division 23 as finally constructed. Provide dimensions of material installed below slab/grade from fixed and visible reference points. Deliver record drawings to the architect in a form suitable for production.

B. Record drawings shall reflect all changes made to the Contract Documents, whether generated by addenda, change orders, or field conditions. Maintain a daily record of these changes and keep current set of drawings showing these changes.

C. Deliver record drawings to Architect within 30 days of Substantial Completion.

1.10 OWNER AND OPERATING MANUALS

A. Comply with the requirements of Division 01, but provide a minimum of three sets, in three ring binders, all sets identical.

B. Manuals shall include clear and comprehensive operating instructions with appropriate graphics and project specific marked data to enable owner to operate and maintain all systems specified in this Division.

C. Copies of approved submittals on furnished equipment shall be included.

PART 2 PRODUCTS

2.01 HANGERS AND SUPPORTS

A. Hangers:
   1. General: Complete with rods and supports proportioned to the size of piping or equipment to be supported.
2. For steel pipe: Steel or malleable iron, unless specified otherwise herein.
3. For heating water, 3" and larger: Anvil 171, B-Line B3114, or ERICO 605 roll type with Anvil 160, B-Line B3160, or ERICO 630 pipe covering protection saddles.
4. For copper piping: copper-plates; Anvil CT-69, B-Line B3170 CT, or ERICO 101.
5. For chilled water: galvanized, Anvil 260, B-Line B3100, or ERICO 401.

B. Hanger Rods:
1. One-piece steel type, threaded as required.
2. Sizes, unless specified otherwise herein, shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and smaller</td>
<td>0.375&quot;</td>
</tr>
<tr>
<td>2.5&quot; and 3&quot;</td>
<td>0.5&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
<td>0.625&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>0.75&quot;</td>
</tr>
<tr>
<td>10&quot;-12&quot;</td>
<td>0.875&quot;</td>
</tr>
<tr>
<td>14&quot;-18&quot;</td>
<td>1.0&quot;</td>
</tr>
</tbody>
</table>

3. Sizes for gang or multiple hangers: Calculated for the combined weight of the piping and accessories.
4. Sizes for equipment hangers: Calculated for the weight of the equipment supported.

C. Inserts:
1. Adjustable type: Anvil 282, B-Line B3014, or ERICO 355.
2. Continuous type: Anvil PS-5000, B-Line B321, or ERICO CON.

D. Expansion Anchors:
1. In concrete: Wedge, self-drilling, or drilled flush type.
2. In masonry: Sleeve type.
3. Manufacturer: Hilti, ITW Ramset/Red Head, or Rawl.

E. Insulation Protectors: Anvil 167, B-Line B3151, or ERICO 125.

F. Channel strut systems: 14 gauge minimum galvanized steel, with factory-punched attachment holes. Straps shall be designed so that the attachment nut is captive on the shoulder of the strap when tightened. Attachment nuts shall be designed to provide a surface on the turned down edge while making positive contact with the side walls of the channel. Nuts, bolts, straps, and accessories shall be protected with same finish as channels.
1. Manufacturer: B-Line, Kindorf, Midland-Ross, or Unistrut.

G. Pipe Stand Supports:
1. For chilled water piping: adjustable pipe saddles, stanchion type with locknut nipple, reducer, flange and baseplate. Provide U-bolt yoke for pipe 12" and smaller.
2.02 EQUIPMENT SUPPORTS

A. Structural steel for supports: ASTM A36.
   1. Use galvanized members installed in fan plenums or areas of high
      humidity or condensation, and outside.
   2. Furnish other members with shop coat of red primer.
   3. Retouch primer after field welding.

2.03 FLASHINGS AND COUNTERFLASHINGS

A. Furnish materials and coordinate installation for flashing and
   counterflashing roof penetrations for vents, pipe, drains, and ducts.

PART 3 EXECUTION

3.01 EXCAVATING AND BACKFILLING

A. Provide trenching, excavating, and backfilling necessary for performance
   of mechanical work in accordance with Division 02.

3.02 CUTTING AND PATCHING

A. Repair or replace damage caused by cutting or installation of work
   specified in Division 23.

B. Perform repairs with materials which match existing and install in
   accordance with the appropriate section of these specifications.

3.03 FLASHING AND COUNTERFLASHING

A. Counterflash ducts and pipes where penetration of roofs and outside
   walls occur.

3.04 DELIVERY, STORAGE, AND PROTECTION

A. Insofar as possible, deliver items in manufacturer's original unopened
   packaging. Where deliver in original packaging is not practical, provide
   cover and shielding for all items with protective materials to keep them
   from being damaged. Use care in loading, transporting, unloading, and
   storing to keep items from being damaged.

B. Store items in a clean, dry place, and protect from damage. Mechanical
   equipment may not be staged or stored outdoors unless intended for
   outdoor use.

C. Protect nameplates on motors, pumps, and similar equipment. Do not
   paint or insulate over nameplate data.
D. Protect valves and piping from damage. Cover equipment during work of finishing trades.

E. Keep dirt and debris out of pipes and ducts.

F. Repair, restore, and replace damaged items.

G. Cover factory finished equipment during work of finished trades, such as fan coils, fin tubes, etc.

H. Protect cooling and/or heating coils with temporary filter media during construction.

**3.05 OPERATION OF HVAC SYSTEMS DURING CONSTRUCTION**

A. Install specified filters prior to system operation. In addition to specified filters, install a roughing filter upstream of mixed air filter. Roughing filter shall consist of two layers of roll filter media clipped and sealed to entering side of filter frame (MERV 8 minimum). Change roughing filter as necessary to minimize dust collection on specified filters.

B. Cover and return and exhaust air grilles with temporary filter media (MERV 8 minimum). Attach media to avoid damage to grille or ceiling. Change temporary media as required to protect against dust buildup on ductwork. Remove temporary media from grilles after flooring is installed, walls are sanded and painted and other dust generating construction has been completed.

C. During period of excessive dust generation such as drywall sanding, seal off return and exhaust openings and grilles to prevent dust from accumulating in ductwork.

D. Furnish and install a new set of specified filter media prior to start of system test and balance. Furnish a new, clean set of the specified media and turn over to Owner’s Representative.

**3.06 EQUIPMENT GUARDS**

A. Use suitable structural frames with minimum 12 gauge, 3/4” galvanized mesh, or expanded metal mesh. Attach to equipment by removable clips and bolts with wing nuts, or other approved connectors.

B. At belts, provide opening for measuring RPMs.

C. Provide at all belts, couplings, moving machinery and equipment.

D. Design for easy access to belts and other items required replacement.

E. Comply with OSHA regulations.
3.07 CLEANING HVAC SYSTEMS

A. General Cleanup:
   1. Upon completion of contract and progressively as work proceeds, clean up dirt, debris, oil materials, etc., and remove from site, keeping premises in neat and clean condition to satisfaction of the Architect.
   2. Seepage, discoloration or other damage to parts of the building, its finish, or furnishings due to Contractor's failure to properly clean piping systems or duct systems shall be repaired without cost to the Owner.

B. Factory Finishes:
   1. Clean items with factory finishes. Touch up bare places, scratches and other minor damage to finishes. Use only factory supplied paint of matching color and formula. If finishes are badly damaged or if there are many damaged, scratched or bare places, refinish the entire item.

C. Ducts and Apparatus:
   1. Thoroughly clean ducts and apparatus casings before fans and filters are operated.

3.08 CLEANING

A. Thoroughly clean ductwork and equipment casings before fans and filters are operated.

B. Repair damaged factory finishes covering all bare places and scratches.

C. Cleaning HVAC Systems Water Piping:
   1. Clean all equipment and piping of iron cuttings and other foreign matter as they are installed.
   2. Thoroughly flush HVAC water systems with precleaning chemicals designed to remove depositions such as pipe dope, oils, rust, mill scale, and other extraneous materials. Provide dosages of precleaner chemicals recommended by water treatment supplier and add and circulate throughout the water systems. Drain, refill, and flush water systems thoroughly until no foreign matter is observed and total alkalinity of the drain water is equal to that of the make-up water.
   3. Do not install devices in which foreign matter could become lodged such as control valves, until cleaning and flushing are completed. Position valves to bypass chiller and boiler. Connect supply and return runouts together at each coil location. Make connection of supply and return runouts with short lengths of high pressure rubber hose and brass fittings. One fitting shall be swivel type to eliminate turning fitting in hose.
   4. Fill system at city water make-up connection with all air vents open. After filling, close vents.
   5. Start main pump with pressure reducing valve makeup open.
Check vents in sequence to bleed off any trapped air in order to assure circulation through all components of system. Verify pumps are properly aligned and bolted down before start-up to prevent damage to seals or couplings. Circulate water for at least two hours and then drain completely to flush out foreign matter.

6. Remove, clean, and replace all strainer baskets. Clean all dirt legs. If indications are found of excessive dirt, repeat the above flushing.

7. Fill the system with fresh water, adding precleaning chemicals designed to remove depositions such as pipe dope, oils, rust, mill scale, and other extraneous materials. Provide dosages of precleaner chemicals recommended by water treatment supplier. Alternate operation of primary and standby pumps, and circulate the cleaning solution for 24 hours. Then turn off the pump and completely drain the system.

8. Remove, clean, and replace all strainer baskets. Clean all dirt legs. Replace suction diffuser start-up strainer with conventional strainer. Refill the system with clean water, venting all high points and equipment of air and gases. Bring water systems to operating temperature. Recheck all vent points during this process and remove all air.

9. After the system has been completely cleaned, test system by litmus paper or other dependable method and leave system on slightly alkaline side (ph 7.5 to 8.5). If system is still on acid side (ph 7.0 or lower), add water conditioner.

3.09 TESTING MECHANICAL SYSTEMS

A. Test all systems and equipment installed to demonstrate proper operation.

B. Advise Architect of scheduled systems testing and completed system demonstration/operation schedules so that he may witness, if desired.

C. Correct and retest work found defective when tested.

D. Make repairs to piping systems with new materials. Peening, doping, or caulking of joints or holes will not be acceptable.

E. HVAC Circulating Water Piping: Hydrostatically test piping at 150 psig pressure or at 1-1/2 times design pressure as indicated on drawings, whichever is greater, for a period of six hours without evidence of leaking.

F. Records of Testing: Maintain records of system testing and results thereof. Deliver results as part of project closing file and on an intermediate basis as requested by Architect.

END OF SECTION
SECTION 23 05 05

USE OF MECHANICAL SYSTEMS

PART 1  GENERAL

1.01  GENERAL

A. Provide all labor, materials, tools, and services required; maintain warranties and keep equipment in operating condition.

B. Principal equipment included are:
1. Chillers
2. Pumps
3. Air Handling Units
4. Fan Coil Units
5. Variable Air Volume Boxes
6. Variable Frequency Drives (VFD)
7. Fans
8. Air Distribution Devices
9. Control System

C. No mechanical equipment shall be operated until the equipment has been started, approved and signed off by the equipment's respective supplier.

D. Air handlers shall be operated only in areas where painting and ceiling work is in progress. Air handlers shall not be operated when concrete grinding or drywall finishing is in progress.

E. When an air handler is placed in service, pre-filters shall be changed on a weekly basis. The Contractor shall maintain logs showing when filters are changed.

F. Air handlers shall not be operated over 30 Hz until factory start up is complete and copies of the start up report are provided to the Designer for approval.

G. The chillers shall not be operated until factory start up is complete and copies of the start up report are provided to the Designer for approval.

H. After start up of the chillers, the contractor shall visit the site at least three times a day to inspect and fill out Owner's equipment logs.

I. The chillers shall not be operated until the water treatment systems are fully functional.

J. If air handling units are used during construction, filtration media with a minimum efficiency of MERV8 shall be used at each return grille.

K. Protect all HVAC equipment from both dust and odors.
L. Seal all duct and equipment openings with plastic. Protect the return/negative pressure side of all systems. Install and maintain (replace weekly) temporary filters over grilles and openings. The temporary filters shall have a rating of MERV8 or better.

1.02 CLEANING

A. Thoroughly clean ductwork, equipment casings, coils and VAV boxes and replace filters before turning equipment over to the Owner. Units having visible signs of construction dust will not be accepted.

B. Repair damaged factory finishes covering all bare places and scratches.

C. Thoroughly clean chilled water and hot water systems before system is turned over to the Owner.

PART 2 PRODUCTS - NOT APPLICABLE

PART 3 EXECUTION - NOT APPLICABLE

END OF SECTION
SECTION 23 05 13

MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1  GENERAL

1.01 SUBMITTALS
A. Submit motor information with submittals and shop drawings.

1.02 REFERENCE STANDARDS
A. All equipment and material furnished and installed on this project shall be UL or ETL listed in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use on this project.

PART 2  PRODUCTS

2.01 MOTORS
A. Acceptable manufacturers: MagneTek or Lincoln.

B. In general, motor voltages shall be as follows, unless specified or indicated otherwise:
   1. 3/4 hp and larger: 208V or 460V, three (3) phase, 60 hertz
      (reference drawings)
   2. Smaller than 3/4 hp: 120V, one (1) phase, 60 hertz

C. All motors shall be started across the line, unless specified otherwise. Motors shall be selected with low starting current and shall be designed for continuous duty to provide the running torque and pull in torque required to suit the load. Unless otherwise indicated on the Contract Documents, all motors shall be single speed (1750 rpm). All motors shall have standard open drip proof enclosures unless otherwise specified. All motors exposed to the actually installed outside in the weather shall be of the totally enclosed fan cooled (TEFC) or totally enclosed air over (TEAO) types. All motors not utilized with variable speed drives shall have a minimum service factor of 1.15 and shall be selected to operate at design conditions without exceeding their nameplate rating (without exploiting the service factor rating). Motors used in conjunction with variable speed drives shall have a 1.00 service factor unless otherwise indicated and be compatible with the drive and rated for inverter output duty.
   1. Standard open drip proof three (3) phase motors ten (10) horsepower and smaller shall have cast aluminum end bells with steel frames. Three (3) phase motors fifteen (15) horsepower and larger shall have cast iron end bells and housings.
   2. Standard open drip proof single phase motors shall have cast aluminum end bells with steel frames.
   3. Totally enclosed fan cooled (TEFC) and totally enclosed air over (TEAO) three (3) phase motors shall have cast iron housings. TEFC motors shall have corrosion resistant fans.
D. Windings and Insulation:
1. All motors shall have copper windings.
2. Motors shall be equipped with Class B, 80°C rise or Class F, 105°C rise insulation suitable for use in a 40°C ambient temperature. Windings shall be treated with an epoxy varnish to inhibit the absorption of moisture.

E. Bearings:
1. Single phase, fractional horsepower motors shall be equipped with quiet operating, all angle, babbitt lined sleeve bearings.
2. Polyphase motors shall be equipped with deep groove type ball bearings, generously sized for the loads to which applied and for severe duty application. Provide the necessary seals on the shaft to keep the bearing system free of contamination and moisture. Lubricant shall be high temperature, nonbleeding grease.
a. Provide inlet and outlet plugs on poly-phase motors so that grease fittings can be easily inserted for bearing relubrication except as otherwise specified. The end shields shall be carefully machined to add extra grease capacity. Lower outlet plugs shall be equipped with combination breather/drains on TEFC and TEAO motors.

F. Motors shall be specifically designed for quiet operation and for severe duty. Standard open drip proof motors shall be equipped with aluminum or stainless steel stamped nameplates. Totally enclosed fan cooled and air over motors shall be equipped with stainless steel stamped nameplates with either zinc or cadmium plated hardware. Motor nameplates shall clearly indicate frame size, horsepower, frequency, voltage, speed, starting torque class, insulation class, service factor and winding material.

G. Motors on belt driver equipment shall have slide rails with adjusting screws for belt tension adjustment. Motors exposed to the weather shall be weather protected.

H. Motors specified with variable frequency drive controllers shall be inverter duty rated and shall be insulated against eddy currents.

I. Install premium efficiency electric motors for motors 1 horsepower and above. Premium efficiency motors shall have efficiency and losses determined in accordance with the latest revisions of IEEE Standard 112. Polyphase squirrel-cage motors rated 1 through 125 horsepower shall be tested by dynamometer method B. The efficiency will be determined using segregated losses in which stray load loss is obtained from a linear regression analysis to reduce the effect of random errors in the test measurements. Guaranteed minimum load efficiency shall be as follows:
1. HP: 3/4 Eff: 80%
2. HP: 1 Eff: 84%
3. HP: 1-1/2 Eff: 86.5%
4. HP: 2 Eff: 86.5%
5. HP: 3 Eff: 89.5%
6. HP: 5 Eff: 89.5%
7. HP:  7-1/2  Eff:  91.7%
8. HP:  10  Eff:  91.7%
9. HP:  15  Eff:  93.0%
10. HP:  20  Eff:  93.6%
11. HP:  25  Eff:  93.6%
12. HP:  30  Eff:  94.1%
13. HP:  40  Eff:  94.5%
14. HP:  50  Eff:  95.0%
15. HP:  60  Eff:  95.4%
16. HP:  75  Eff:  95.4%

J. Sound power levels not greater than recommended in NEMA M61-12.49. VFD duty rated motors shall not increase by more than 3 dB when operating on VFD.

K. Provide motors with drive shafts long enough to extend completely through belt sheaves when sheaves are properly aligned or balanced.

2.02 STARTERS

A. Starters shall be as manufactured by Square D or approved substitute.

B. Starters used on 208-volt systems shall have two cartridge fuses in the control circuit.

C. Starters used on 480-volt systems shall have an individual 480/120-volt control transformer with two cartridge fuses in the primary and one in the secondary.

D. All starters to be provided with melting alloy overloads.

E. Starters used inside shall have NEMA 1 enclosures; starters used in damp locations or exposed to the weather to have NEMA 3R enclosures.

F. Manual Motor Starter with Heater Unit:  Square D Class 2510.

G. Provide starters with disconnect switch.

H. Starters mounted in motor control center are specified under Division 26.

I. Single speed motors 25 horsepower and larger to have power factor correction capacitors.

PART 3  EXECUTION

3.01 INSTALLATION

A. Arrange and set motors.

B. Line up motors on direct drive equipment using dial type gauges.
C. Make connections and test motor for proper rotation/phasing under Division 26.

3.02 ADJUSTMENTS

A. Motors, together with driven equipment, shall be dynamically and statically balanced. Imbalance shall be reduced to minimum specified by equipment manufacturers.

B. Fan vibration should be limited to manufacturer's recommendations, but should not exceed 2 mils in any case.

END OF SECTION
PART 1  GENERAL

1.01  GENERAL

A. Furnish complete variable frequency motor controllers (VSMC) for fans and pumps designated.

1.02  WARRANTY

A. The VSMC shall be warranted by the manufacturer for a period of 36 months from date of start-up. The warranty shall include parts and labor.

B. During warranty period, any warranty expense shall be born by the manufacturer, including travel costs or living expenses necessary to repair in warranty equipment.

PART 2  PRODUCTS

2.01  ACCEPTABLE MANUFACTURERS

A. ABB or approved equal.

2.02  DRIVE TECHNOLOGY

A. Solid state design to transform input power into frequency and voltage controlled 3-phase output power suitable to provide positive speed and torque control to standard induction motors.

B. Front end: Input line filters as integral part of drive.

C. Invertor section: Transistorized sinecode pulse width modulation. Employ power transistors in the invertor without paralleling.

D. Power factor: Minimum of .95 and an efficiency of 95% at 100% full output.

E. Increase in audible motor noise with drive operating shall not exceed 3 decibels.

2.03  EQUIPMENT REQUIREMENTS

A. Enclosure: NEMA 1 enclosure with deadsides for installation in an individual wall installation.

B. Input disconnect: Integral, magnetic trip only circuit breaker or non-fused switch.

C. Ratings:
   1. Provide symmetrical A/C rating of 100,000 amps for fused input drives.
2. Provide symmetrical A/C ratings of 50,000 amps for other than fused
input drives at 460 volts and 35,000 amps for other than fused inputs at
lower voltages.
3. Provide higher ratings where available fault current exceeds these levels
and as called for on drawings.

D. Provide an integral bypass contactor for operation of motor at constant speed,
electrically independent of the inverter. Include motor overload protection when
in bypass mode. Include necessary control relays and switches to allow auto-
matic controls and safeties to operate when drive is in bypass mode.

E. Features and Specifications:
1. Horsepower Rating: As scheduled on drawings.
2. Input power: 460 VAC +/- 10%, 60 HZ +/- 3%.
3. Output power: 0-460 volts, 1-60 HZ.
4. Ambient temperatures:
   a. Drive operating: 32 degrees F. to 104 degrees F.
   b. Drive storage: 68 degrees F. to 140 degrees F.
5. Output Frequency Stability: Shall not vary with load, temperature or with
   +/- 10% input frequency variations.
6. The VSMC shall include a plug-in test meter for monitoring the different
   signals within the VSMC for start up and troubleshooting.

F. Speed Control:
1. The output frequency may be adjusted in proportion to any one of the
   following:
   a. 0-10 VDC Analog Signal.
   b. 0-5 VDC Analog Signal.
   c. 4-20 MA DC Analog Signal.

G. Start-Stop Control: Drive may be started or stopped by any one of the following:
1. A contact closure.
2. Use of a motor starter or contactor in the input power line.
3. The speed control signal dropping below or rising above minimum.
4. An external 115 VAC signal.

H. Customer Contacts: Single pole, double throw contact which changes state on
trip condition.

I. 115 Volt AC Power Supply: Used to provide a remote enabled indication.

J. Building Automation System Interface: Provide VFD interface to duplicate all
points monitored locally at VFD into the BAS. Interface shall connect to BAS
network communication bus.

2.04 SELF PROTECTION AND RELIABILITY FEATURES

A. Current Limit: Limit output current to 110% of inverter rating.

B. Instantaneous Overcurrent Trip: Limit output current in under 50 microseconds
due to phase-to-phase short circuits or severe overload conditions.
C. Undervoltage Trip: Protect the inverter due to voltage levels in excess of its rating. Activates automatically when the DC bus in the controller exceeds 1000 VDC.

D. Overtemperature Trip: Protect the inverter from elevated temperatures in excess of rated temperatures.

E. Automatic Reset/Restart:
   1. Automatic reset on trip condition resulting from overcurrent, undervoltage, overvoltage, or overtemperature after removal or correction of the causative condition.
   2. Provide unlimited number of reset/restarts for undervoltage, overvoltage, and overtemperature.
   3. Limit the number of reset/restarts for overcurrent and require manual reset.

F. Isolation: Isolated current and voltage signals from logic circuitry.

G. Drive Logic: Microprocessor based.

H. Sustained Power Loss: In the event of a sustained power loss, shut down without component failure. Upon return of power, automatically return drive to normal operation if the start is in the "ON" condition.

I. Momentary Power Loss: In the event of a momentary power loss, shut down without component failure. Upon return of power, automatically return drive to normal operation, if the start is in the "ON" condition, being able to restart into a rotating motor regaining positive speed control without shutdown or component failure.

J. Short Circuit Protection: In the event of a phase-to-phase short circuit, shutdown safely without component failure.

K. Power Interruption: In the event that an input or output power contactor is opened or closed while the drive is activated, no damage to the control shall result.

L. Critical frequency avoidance circuit: Minimum of six user selectable bands to avoid operation at speeds which cause excessive vibration or noise in the driven equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and connect equipment in locations specified on Contract Drawings in strict accordance with the manufacturer's instructions.

B. Provide materials and assistance as required by the manufacturer's representative.

C. Coordinate installation with requirements for HVAC temperature controls.
D. Electrical:
1. Control systems, components and control and interlock wiring for mechanical equipment will be furnished under this division.
2. Provide power wiring to drives under Division 26. Power wiring shall consist of wiring to the line side terminals wiring away from the load side terminals to the equipment, except where such wiring is installed pre-wired by the equipment vendor such as for chiller units.
3. Fire alarm control wiring among duct mounted smoke detectors, fire alarm system, drives, ATC panels DDC panels shall be furnished under Division 28.

E. Label enclosures with engraved plastic nameplate describing the equipment served, e.g. "AHU-1". Nameplates shall be attached with screws or rivets. Adhesives shall not be used to secure the nameplates.

3.02 START-UP, TESTING, DEMONSTRATION

A. Provide a factory trained technician to supervise the installation, start-up and testing of drives. As a minimum, check the following items:
1. Motor voltage and frequency.
2. Control input and automatic start/stop.
3. Calibration and adjustment for minimum and maximum speed set points and acceleration and deceleration rates.

B. Provide a minimum of one day (8 hours) instruction to maintenance personnel.

C. Demonstrate the operation of the system to the maintenance personnel.

D. Provide the necessary coordination for test and balance procedure as required by Section 23 05 93.

END OF SECTION
SECTION 23 05 17

SLEEVES, ESCUTCHEONS, AND SLEEVE SEALS FOR HVAC PIPING

PART 1   GENERAL (Not Applicable)

PART 2   PRODUCTS

2.01   SLEEVES

A. Sleeves shall be standard weight steel pipe except sleeves for concealed piping through floors not in structural members, and through interior dry-wall construction may be formed from 26 gauge galvanized sheet metal lapped and pop riveted.

2.02   EXTERIOR WALL - SLEEVE-SEAL SYSTEMS

A. Exterior Wall & Steam Vault Penetration System by Link-Seal or approved equal.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03   SLEEVES

A. Materials
   1. Concrete floors, concrete and masonry walls: 18 gauge galvanized sheet metal.
   2. Drywall partitions: 18 gauge galvanized steel sheet metal

B. Sleeves shall be sized such that the annular space between outside surface of pipe or pipe insulation and the inside surface of the sleeve is not less than 1/2". Provide larger annular space if required by firestopping product installation instructions

C. Sleeves supporting riser piping 4" and larger shall have three 6" long reinforcing rods welded radically at 120 degree spacing to the sleeve and shall be installed with the rods embedded in the concrete slab

2.04   PENETRATION SEALS

A. Refer to architectural specification for Fire Safing.
2.05 GROUT

A. Non-shrink type, conforming to ASTM C1107/C1107M-2013 when tested at fluid consistency. Grout shall exhibit zero bleeding at every age when mixed to fluid consistency. Minimum 28 day compressive strength, when mixed to fluid consistency, shall be 7000 psi.

B. Manufacturer: Cormix or Master Builders.

2.06 ESCUTCHEON PLATES

A. Provide chromium plated escutcheon plates for exposed, uninsulated pipes projecting through floors or walls in "finished" spaces. Mechanical rooms, store rooms, electrical closets and janitor closets are not considered "finished" spaces.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

1. Piping requiring sleeves:
   a. Heating hot water
   b. Chilled water
   c. Copper pipes thru masonry walls

B. Where a pipe requiring sleeves passes through a wall, ceiling or floor slab, a steel sleeve shall be provided and the internal diameter of the sleeve shall be 2" larger than the external diameter of the pipe or insulated pipe passing through it. After all the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary to within 1/2". Then the void shall be packed full depth with glass/mineral fiber and sealed at both ends, 1" deep with sealant backed by foam rod. Nothing in these paragraphs shall override the fire penetration details shown on the drawings.

C. Pipe sleeves shall be provided at non-rated partitions and floor penetrations. Pipe sleeves to be Schedule 40 or 18 gage steel. Sleeves to extend 1-1/2" in excess of partition depth on each side. Sleeves penetrating floors in wet areas, including all mechanical rooms, shall extend a minimum of 1 inch above the floor.

1. Sleeves are not required for core-drilled holes.

D. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
E. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 ESCUTCHEONS

A. Provide escutcheons where exposed piping passes through walls, floors, and ceilings in finished areas.

3.04 SLEEVES

A. Floors: Sleeve all pipe penetrations. Extend sleeve 1-1/2" above finished floor, except piping within pipe chases. Sleeve shall be flush with underside of floor.

B. Masonry or concrete walls: Sleeve all pipe penetrations. Sleeves shall be flush on both sides of wall.

C. Drywall partitions: Sleeve all penetration of piping in systems over 160 degree F.

D. Seal voids between outside surface of sleeve and wall, partition or floor. Seals shall be airtight.

E. Install piping, insulation and sleeves in strict accordance with applicable U.L. floor or partition assembly instructions. Coordinate with Division 07 firestop manufacturer's installation instructions.

F. Penetrations not sleeved or fire-stopped:
1. Seal voids between pipe and partition. Seals shall be airtight.

3.05 ESCUTCHEON PLATES

A. Provide chromium plates escutcheon plates for exposed uninsulated pipes projecting through floors or walls in "finished" spaces. Mechanical rooms, store rooms, electric closets, and janitor closets are not considered "finished" spaces.

B. Clearance between sleeve and pipe: Minimum of 1/2 inch for hot piping and 1 inch for cold piping or as otherwise dictated by U.L. Fire Resistance Directory.

END OF SECTION
SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1  GENERAL (NOT USED)

PART 2  PRODUCTS

2.01  HANGERS

A. Anvil Figure #260 clevis hangers with Figure 167, MSS Type 40 galvanized insulation protection shields (sized for supporting insulation having a compressive strength of 4 psi). Support piping on outside of insulation. Size hangers so that pipe insulation passes through them without interruption.
   1. Hot water piping above 160 degrees F. 4” diameter and less.
   2. Chilled water piping.

B. Anvil Figure #171, MSS Type 41 with pipe roller, Anvil Figure #16x protection saddle and Anvil Figure 167, MSS Type 40 galvanized insulation protection shields (sized for supporting insulation having a compressive strength of 4 psi, at 8 foot intervals). Support piping on outside of insulation. Size hangers so that pipe insulation passes through them without interruption. Use these for:
   1. Hot water reheat above 160 degrees F. 6” diameter and larger.

C. Anvil Figure #CT-121, MSS Type 8, riser clamps (at floor penetrations) to support:
   1. Copper pipe risers

D. Anvil Figure #261, MSS Type 8, riser clamps (at floor slab penetrations) to support:
   1. Steel pipe risers

E. Anvil Powerstrut Trapeze Hangers: Where three or more lines of pipe run parallel, support them with trapeze hangers, sized for maximum 3/16” deflection.

2.02  INSERTS

A. Concrete Insert: Anvil Figure #281, MSS Type 18, universal concrete inserts, adequately sized and correctly positioned to support full load operating systems.

B. Concrete Insert, Wedge Type: Anvil Figure #281, 1/4” to 7/8”.

C. Lightweight Concrete Insert: Anvil Figure #285.

D. Continuous Concrete Insert: Anvil Powerstrut Figure #PS-349 pre-galvanized.
2.03 EXPANSION ANCHORS
   A. Hilti Kwik-bolt, zinc plated, metal expansion anchor.
   B. Anchor to meet U.L., ICBO-4627 and FM listings.

2.04 CLAMPS
   A. C-Clamps: Anvil Figure #92, MSS Type 23.
      1. Use these for attaching hangers to steel beams. Do not weld hanger rods to structural steel members.
   B. Malleable Beam Clamps: Anvil Figure #218, MSS Type 30: Use these for attaching hangers to bar joists.

2.05 HANGERS RODS
   A. Provide mild steel, all-thread rods with maximum loads as follows:
      1. 3/8" - 300 lbs.
      2. 1/2" - 600 lbs.
      3. 5/8" - 1,200 lbs.
      4. 3/4" - 2,000 lbs.
      5. 1" - 5,000 lbs.

2.06 TRAPEZE PIPE HANGERS
   A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.07 THERMAL-HANGER SHIELD INSERTS
   A. Protect insulation at each hanger and support point with a 14 gauge galvanized shield which extends up to the centerline of the pipe and is centered inside the pipe hanger. Minimum shield length shall be 12". Provide a section of foam glass insulation between pipe and metal shield where glass fiberglass insulation is used on 3" and larger.

2.08 FASTENER SYSTEMS
   A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
2.09 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 UNISTRUT

A. Provide floor mounted Unistrut for variable frequency drives and control panels as required.

2.11 ROOF CURBS

A. Provide prefabricated metal roof curbs at all roof ductwork and piping penetrations and for support of all roof-mounted equipment, fans and ductwork. Construct curbs according to National Roof Contractor’s Association guidelines. Prefabricated metal roof curbs shall be manufactured by ThyCurb, Custom Curb, or approved substitute.

B. Construction curbs with minimum 18 gauge galvanized steel (14 gauge for curbs with any side longer than 4'-0" and for all curbs supporting equipment) with fully mitered and welded corners, integral base plate, internal reinforcing with 1" x 1" x 1/8" steel angle for curbs with any side longer than 3'-0", factory installed 1-1/2" thick, 3-pound density fiberglass insulation and factory installed pressure treated wood nailer. Minimum height of curb shall be 12” above finished roof surface. Consult architectural plans for roof type and thickness. Construct curbs to match slope of roof and provide a level top surface for mounting of mechanical equipment. Non-ducted equipment curbs shall be turned such that they are parallel to the slope of the roof (short side faces on-coming water).

C. Curb types shall be as follows:
   1. Fan and duct penetration curbs with standard curb construction as described above - Thy Curb Model TC-3 with no cant.
   2. Equipment support curbs with minimum 18 gauge galvanized steel shell, base plate and counterflashing, wood nailer, and internal bulkhead reinforcement - ThyCurb Model TEMS.

D. Install curbs in strict accordance with manufacturer’s published installation instructions and as detailed on the drawings. Coordinate proper curb size, construction, and base prior to fabrication.

2.12 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
PART 3  EXECUTION

3.01  HANGER AND SUPPORT INSTALLATION

A.  Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B.  Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1.  Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2.  Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C.  Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D.  Fastener System Installation:
   1.  Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer’s operating manual.
   2.  Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions.

E.  Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F.  Equipment support in first paragraph below requires calculating and detailing at each use.

G.  Equipment Support Installation: Fabricate from welded-structural-steel shapes, expansion bends, and similar units.

I.  Install lateral bracing with pipe hangers and supports to prevent swaying.

J.  Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:
1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified Division 09.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
   6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
   8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
   9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450°F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   6. C-Clamps (MSS Type 23): For structural shapes.
   7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
      a. Light (MSS Type 31): 750 lb.
      b. Medium (MSS Type 32): 1500 lb.
      c. Heavy (MSS Type 33): 3000 lb.
   8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
   9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
   3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION
SECTION 23 05 33

HEAT TRACING FOR EXTERIOR CHILLED WATER PIPING

PART 1  GENERAL

1.01 SUMMARY

A. Furnish and install a complete U.L. listed system of heaters, components, and controls to prevent chilled water pipe lines from freezing.

1.02 WARRANTY

A. Provide three years warranty from date of Substantial Completion. Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

PART 2  PRODUCTS

2.01 SELF-REGULATING HEATING CABLES

A. Comply with IEEE 515.1.

B. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating. The heater shall be equivalent to Raychem XL-Trace, Chromalox Rapid Trace or approved equal.

C. Electrical Insulating Jacket: Flame-retardant polyolefin.

D. Cable Cover: The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.

E. Maximum Operating Temperature (Power On): 150 deg F.

F. Maximum Exposure Temperature (Power Off): 185 deg F.

G. 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.

H. Capacities and Characteristics:

<table>
<thead>
<tr>
<th>Diameter of Pipe</th>
<th>Watts/Foot of Pipe @ 40°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inch or less</td>
<td>5</td>
</tr>
<tr>
<td>4 to 6</td>
<td>8</td>
</tr>
</tbody>
</table>
2.02 CONTROLS

A. The system shall be controlled by an ambient sensing thermostat set at 40 degrees F. either directly or through an appropriate contractor.

B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.

D. Corrosion-resistant, waterproof control enclosure.

2.03 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Section 230553 "Identification for HVAC Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing": vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
   1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
   2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install electric heating cable across expansion joints in strict accordance with manufacturer's written instructions; use slack cable to allow movement without damage to cable.

B. Install electric heating cables after piping has been tested and before insulation is installed.

C. Install electric heating cables according to IEEE 515.1.

D. Install insulation over piping with electric cables according to Section 230719 "HVAC Equipment and Piping Insulation."
E. Install warning tape on piping insulation where piping is equipped with electric heating cables.

F. Set field-adjustable switches and circuit-breaker trip ranges.

G. Ground fault equipment according to Section 427-22 of the National Electric Code.

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.02 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
   2. Test cables for electrical continuity and insulation integrity before energizing.
   3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. Remove and replace damaged heat-tracing cables.

END OF SECTION
SECTION 23 05 48

VIBRATION ISOLATION FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Isolate equipment as specified herein with factory-fabricated vibration isolators. Provide isolators of proper sizes and weight to meet the requirement.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Kinetics Noise Control or Mason Industries. Provide isolators by a single manufacturer.

2.02 FIBERGLASS OR NEOPRENE PADS

A. Provide Kinetics Model KIP
   1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
   2. Size: Factory or field cut to match requirements of supported equipment.
   3. Pad Material: Oil and water resistant with elastomeric properties.
   5. Infused nonwoven cotton or synthetic fibers.

B. Provide isolation pads for:
   1. Chilled water pumps.
   2. Hot water pumps.

2.03 SPRING AND RUBBER ISOLATION HANGERS

A. Provide Kinetics Model SFH or SRH for:
   1. Suspended square in-line centrifugal fans (minimum 1.0" deflection).
   2. Suspended unit heaters (minimum 1.0" deflection).
   3. First three (3) piping hangers on each side of air handling units and pumps (minimum 1.5" deflection).
   4. Suspended centrifugal in line fans (minimum 2" deflection)

2.04 FLEXIBLE PIPE CONNECTORS

A. Provide Metraflex or approved substitute twin-sphere flexible rubber pipe connectors with female unions or floating flanges on piping connections to equipment subject to vibration.
B. Provide connectors rated for 150 PSI working pressure.

C. Provide flexible pipe connectors for the following:
   1. Water connections to pumps.
   2. Water connections to air handling units.
   3. Water connections to air cooled chillers.

2.05 OUTDOOR APPLICATIONS

A. All isolators located outside exposed to weather shall be corrosion resistant construction with hot dip galvanizing or PVC coating.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install vibration isolation in accordance with the isolator and equipment manufacturer's published installation instructions.

B. Size vibration isolation in accordance with weight distribution, pull or the imposed torque of actual equipment provided.

END OF SECTION
SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL
1.01 SUMMARY (Not Applicable)

PART 2 PRODUCTS

2.01 NAMEPLATES AND TAGS
   A. Acceptable manufacturers: Seton Nameplate Corporation or Marking
      Services Inc.
   B. Rigid plastic, "Setonite" or bakelite with engraved lettering, minimum 1/2"
      high.

2.02 PIPE MARKERS
   A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic,
      preformed to fit around pipe or pipe covering.

2.03 PIPE IDENTIFICATION
   A. Identify piping with Snap-on or Strap-on type markers as manufactured by
      Seton or approved substitute. Indicate contents of pipe and direction of
      flow on marker. Install markers on piping not more than 20 feet apart, at
      valves, access panels and above each space. Identify chilled water and
      hot water piping.
   B. All piping in equipment rooms and concealed in accessible spaces (such
      as piping above lay-in ceiling space) shall be labeled to identify contents
      and direction of flow.

2.04 EQUIPMENT AND APPARATUS IDENTIFICATION
   A. Acceptable Manufacturers: Seton Name Plate Corporation or equal.
   B. Nameplates: Rigid plastic, "Setonite" or bakelite, with engraved lettering
      (indicating names and numbers of mechanical apparatus), a minimum of
      1/2" high. Fill engraved lettering with a permanent coloring material which
      contrasts with color of tag material to allow for easy reading.
   C. Use names, numbers, and abbreviations appearing in schedules on
      Contract Drawings.
   D. Provide nameplates, located in a conspicuous location directly on the
      equipment or apparatus, for mechanical equipment including, but not
      limited to:
      1. Chillers
2. Boilers
3. Air Handling Units
4. Variable Volume Terminals
5. Starters
6. Variable Frequency Drives
7. Pumps
8. Fans
9. Fan Coil Units
10. HVAC Equipment
11. Control Panels

E. Equipment Tags: Commercial quality, rust resisting nuts and bolts with backwashers, self-tapping screws, or rivets. Identification tags shall be constructed of engraving stock melamine plastic laminate, 1/8" minimum thickness, black and white core (letter color) punched for mechanical fastening. Letter height shall be minimum 1/2" tall.

F. Control Diagram Frames:
1. Seton Name Plate Corporation, No. 111P aluminum frames, or equal by Brady or Avery, with "plexiglass" or "lucite" glazing.
2. Provide control and systems instructions and diagrams, framed and glazed with specified items. Mount framed diagrams on walls in conspicuous, easily accessible places in each separate mechanical room housing an A/C systems to which the individual diagrams are applicable. The following instructions and diagrams are required:
   a. Control diagrams.
   b. Wiring diagrams.
   c. Sequence of operation, where applicable.
3. Diagrams and instructions may be reduced in size provided they are easily readable and lettering is not smaller than "10 pt." type.

PART 3 EXECUTION (Not Applicable)

END OF SECTION
SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SERVICES

A. The balancing agency shall inspect the installation of the piping systems, sheet metal work, and the temperature controls. A minimum of two inspections shall be performed periodically as work progresses.
   1. When 50 percent of the ductwork and piping is installed.
   2. When 50 percent of the equipment is installed.

B. Perform test and balance in accordance with AABC or NEBB Standards.

C. The TAB Contractor shall work with the Control Contractor to assist in calibrating all airflow and water flow stations and duct and pipe mounted differential pressure sensors and duct mounted temperature sensors.

D. The Contractor shall provide Test and Balance Agency with copy of plans and specifications of Construction Documents. The Contractor shall correct prompt deficiencies of materials and workmanship identified as delaying the completion of the TAB work. The Contractor shall be responsible for any additional costs to the Owner resulting from his failure to have the HVAC systems and Building ready or from his failure to correct deficiencies promptly.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output,
and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.
1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine variable-air-volume boxes, and hot water coils. Verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.
3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Duct systems are complete with terminals installed.
   b. Volume fire dampers are open and functional.
   c. Clean filters are installed.
   d. Fans are operating, free of vibration, and rotating in correct direction.
   e. Variable-frequency controllers’ startup is complete and safeties are verified.
   f. Automatic temperature-control systems are operational.
   g. Ceilings are installed.
   h. Windows and doors are installed.
   i. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning per the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers’ startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC’s "National Standards for Total System Balance" NEBB’s "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA’s "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233713 "Sheet Metal Specialties."

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation" and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 and 233115.
3.05 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:
   1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
   2. Verify that the system is under static pressure control.
   3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
      a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
      b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
      c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
      d. Adjust controls so that terminal is calling for minimum airflow.
      e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
      f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
   5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
      a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
      b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
      c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   6. Measure fan static pressures as follows:
a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
   b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.

9. Verify final system conditions as follows:
   a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
   b. Re-measure and confirm that total airflow is within design.
   c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
   d. Mark final settings.
   e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

3.06 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
   1. Check liquid level in expansion tank.
   2. Check highest vent for adequate pressure.
   3. Check flow-control valves for proper position.
   4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
   5. Verify that motor starters are equipped with properly sized thermal protection.
   6. Check that air has been purged from the system.
PROcedures FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.
   1. Measure total water flow.
      a. Position valves for full flow through coils.
      b. Measure flow by main flow meter, if installed.
      c. If main flow meter is not installed, determine flow by pump
         TDH or exchanger pressure drop.
   2. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet
         flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or
         in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in
         gage heights.
      d. Verify pump impeller size by measuring the TDH with the
discharge valve closed. Note the point on manufacturer's
      pump curve at zero flow, and verify that the pump has the
      intended impeller size.
      e. With valves open, read pump TDH. Adjust pump discharge
      valve until design water flow is achieved.
   3. Monitor motor performance during procedures and do not operate
      motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design
   water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to
   design water flows.
   1. Measure flow at terminals.
   2. Adjust each terminal to design flow.
   3. Re-measure each terminal after it is adjusted.
   4. Position control valves to bypass the coil, and adjust the bypass
      valve to maintain design flow.
   5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:
   1. Measure differential pressure and verify that it is within
      manufacturer's specified range.
   2. Perform temperature tests after flows have been verified.

E. Verify final system conditions as follows:
   1. Re-measure and confirm that total water flow is within design.
   2. Re-measure final pumps' operating data, TDH, volts, amps, and
      static profile.
   3. Mark final settings.

F. Verify that memory stops have been set.
3.08 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:
   1. Verify that the differential-pressure sensor is located as indicated.
   2. Determine whether there is diversity in the system.

C. For systems with no diversity:
   1. Adjust pumps to deliver total design gpm.
   a. Measure total water flow
      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   b. Measure pump TDH as follows:
      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gage heights.
      4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
   2. Adjust flow-measuring devices installed in mains and branches to design water flows.
      a. Measure flow in main and branch pipes.
      b. Adjust main and branch balance valves for design flow.
      c. Re-measure each main and branch after all have been adjusted.
   3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
      a. Measure flow at terminals.
      b. Adjust each terminal to design flow.
      c. Re-measure each terminal after it is adjusted.
      d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
      e. Perform temperature tests after flows have been balanced.
   4. For systems with pressure-independent valves at terminals:
      a. Measure differential pressure and verify that it is within manufacturer's specified range.
      b. Perform temperature tests after flows have been verified.
5. Prior to verifying final system conditions, determine the system differential-pressure set point.
6. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
7. Mark final settings and verify that all memory stops have been set.
8. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.
9. Verify that memory stops have been set.

3.09 TOLERANCES
A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 5 percent.
   3. Heating-Water Flow Rate: Plus or minus 5 percent.
   4. Cooling-Water Flow Rate: Plus or minus 5 percent.
B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT
A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.
   3. Certify validity and accuracy of field data.
B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Fan drive settings including settings and percentage of maximum pitch diameter.
   e. Settings for supply-air, static-pressure controller.
   f. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outdoor, supply, return, and exhaust airflows.
   2. Water flow rates.
   3. Duct, outlet, and inlet sizes.
   4. Pipe and valve sizes and locations.
   5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Unit arrangement and class.
      g. Discharge arrangement.
      h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).

j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches (mm), and bore.
   f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Outdoor-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

F. Chiller test forms - Record the following items for each chiller:
   1. Manufacturer, model number, and serial number
   2. All design and manufacturer's rated data.
   3. Rated and actual pressure drop across evaporators and condensers and related GPM.
   4. Entering and leaving water temperatures for the evaporator and condenser.
   5. Rated and actual operating current and voltage.

G. Chiller:
   1. Record full load entering and leaving chilled water temperatures with glass stem, mercury thermometers accurate to 1/2 degree F.
   2. Record GPM at time of test.
   3. Record amperage and voltage.
   4. Perform log-test for a minimum of one hour taking readings at least every ten minutes.
   5. Average all readings and compute test capacity in BTU/HR. and in tons.
   6. Average all readings and compute actual kw/ton of chiller.

H. Boiler test forms - Record the following items on each boiler test form:
   1. Manufacturer and model number.
   2. All design and manufacturer's rated data.
   3. Service and location.
   4. Actual pressure drop and related GPM, primary side.
5. Actual pressure drop and related GPM, secondary side.
6. Primary side entering and leaving temperatures.
7. Secondary side entering and leaving temperatures.
8. Temperature control setting.

I. Pump test forms - Submit pump curve showing design - operating - and no-flow points of operation. Also, record the following items on each pump test form:
1. Manufacturer, size, and serial number.
2. All design and manufacturer's rated data.
3. Pump operating suction and discharge pressure and final total dynamic head.
4. No flow (pump discharge valve closed) suction and discharge pressure and corresponding total dynamic head. This procedure is to determine actual impeller size.
5. Rated and actual operating current, voltage, and brake horsepower of each pump motor as well as starter and heater data.

J. Apparatus-Coil Test Reports:
1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft.
   h. Tube size in NPS (DN).
   i. Tube and fin materials.
   j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm (L/s).
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.

K. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in inches wg.

L. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
   1. Report Data:
      a. System and air-handling-unit number.
      b. Location and zone.
      c. Traverse air temperature in deg F.
      d. Duct static pressure in inches wg.
      e. Duct size in inches.
      f. Duct area in sq. ft.
      g. Indicated airflow rate in cfm.
      h. Indicated velocity in fpm.
      i. Actual airflow rate in cfm.
      j. Actual average velocity in fpm.
      k. Barometric pressure in psig.

M. Air-Terminal-Device Reports:
   1. Unit Data:
      a. System and air-handling unit identification.
      b. Location and zone.
      c. Apparatus used for test.
      d. Area served.
      e. Make.
      f. Number from system diagram.
      g. Type and model number.
      h. Size.
      i. Effective area in sq. ft.
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Air velocity in fpm.
      c. Preliminary airflow rate as needed in cfm.
      d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

N. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
   a. System and air-handling-unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.
   e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Entering-water temperature in deg F.
   c. Leaving-water temperature in deg F.
   d. Water pressure drop in feet of head or psig.
   e. Entering-air temperature in deg F.
   f. Leaving-air temperature in deg F.

O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm.
   g. Water pressure differential in feet of head or psig.
   h. Required net positive suction head in feet of head or psig.
   i. Pump rpm.
   j. Impeller diameter in inches.
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
   p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

P. Instrument Calibration Reports:
1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.11 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.

B. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:
   1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
   2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
   3. If the second verification also fails, Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.
SECTION 23 07 13

DUCT INSULATION

PART 1  GENERAL

1.01  CERTIFICATION/QUALITY ASSURANCE


B. Fire-Test Response Characteristics: Testing in accordance with ASTM E-84. Insulation and related materials, adhesives, coatings, sealers, jackets and tapes, shall have a fire-test response characteristic of: Flame spread rating of 25 or less; Smoke development of 50 or less.

C. Materials shall meet the requirements of NFPA 90-A.

PART 2  PRODUCTS

2.01  DUCTWORK INSULATION

A. Blanket Type Duct Insulation:
   1. Minimum 3/4 pound per cubic foot density, factory-reinforced foil-faced, kraft vapor barrier; with a minimum "R" value of 4.0.
   2. Acceptable manufacturers: Johns-Manville, or Owens Corning.
   3. Use on the following:
      a. Supply and Return - 2" thick.
      b. Reheat coils, including reheat coils at terminal boxes - 1-1/2" thick.
      c. Air flow stations.
      d. Top of supply air diffusers.

E. Board Type Duct Insulation:
   1. Provide minimum 3 pound per cubic foot density semi-rigid, factory-reinforced foil faced Kraft vapor barrier glass fiber board "system" type insulation; having a minimum "R" value of 4.34, unless otherwise specified.
   2. Acceptable manufacturers: Johns-Manville, or Owens Corning.
   3. Use on the following services:
      a. Supply and Return ductwork within Mechanical room - 1-1/2" thick.
      b. Ductwork supply outside air within Mechanical room - 1-1/2" thick
      c. Outside air intake plenums, return air plenums, ductwork and connections to mixing plenums in Mechanical room - 1-1/2" thick.

F. Duct Liner:
   1. Liner: Anti-microbial, 1" thick (unless otherwise indicated on drawings), UL listed, neoprene coated, mat faced, flexible fiberglass of three pounds per cubic foot density. Sizes shown on
the drawings are free area dimensions, after installation of duct liner.

2. Provide liner that complies with UL 181 Erosion Test and has a flame spread rating of 25 or less and a smoke developed rating of 50 or less.
   a. Low pressure supply and return ductwork.
   b. Plenums serving sidewall return and supply grilles.
   c. Plenums serving linear slot diffusers.

**PART 3 EXECUTION**

3.01 INSTALLATION – GENERAL

G. Deliver and store insulation materials in manufacturers containers and kept free from dirt, water, chemical and mechanical damage.

H. Complete ductwork pressure testing prior to applying insulation.

I. Apply insulation in workmanlike manner by experienced, qualified, workmen.

J. Surfaces shall be clean and dry when covering is applied. Covering to be dry when installed and before and during application of any finish, unless such finish requires specifically a wetted surface for application.

K. Adhesives, cements and mastics shall be compatible with materials applied and shall not attack materials in either wet or dry state.

L. Stop duct coverings, including jacket and insulation, at fire penetrations of fire or smoke rated partitions, floors above grade and roofs. “Fan-out” or extend jacketed insulation at least 2” beyond angle frames of fire dampers and secure to wall. Maintain vapor barrier.

3.02 BLANKET TYPE DUCT INSULATION

M. Apply jacketed blanket type glass fiber covering to ducts pulled snug but not so tight as to compress corners more than 1/4”. Use insulation having 2” tab, or cut insulation long enough to allow for "peel-off" of insulation from jacket to effect a minimum overlap of 2”. Staple lap with flare type staples on 1” centers. Cover standing seams, stiffeners, and braces with same insulation blanket, using 2” jacket lap and staple lap as herein before outlined. Cover and seal all staples with Foster 30-80 reinforced with glass cloth. Do not use pressure sensitive tape.

N. Secure jacket to covering using equivalent of Foster No. 85-20 or Childers CP-82 adhesive.

O. For ducts 24” or wider, mechanically fasten insulation to duct bottom, using weld pins having self-locking, metal discs, locating fasteners on not over 12” centers laterally and longitudinally. Seal pins as above.
P. For ducts up to 18" deep, mechanically fasten insulation to duct sides, using one row of pins, plates or discs located on not over 12" centers longitudinally and equidistant laterally between duct top and bottom. For ducts over 24" deep, apply fasteners as before only using minimum of two rows.

3.03 BOARD TYPE DUCT INSULATION

Q. Apply jacketed board type glass fiber covering to ducts using weld pins having self-locking coated metal or nylon discs; locate fasteners on not over 12" centers laterally and longitudinally. If insulation is grooved to fit around corners, in order to eliminate as many joints as possible, pin as required to hold insulation tight to duct, especially on bottom of duct. Seal pins and joints with Foster 30-80 reinforced with glass cloth.

R. Cover all joints, rips, tears, punctures, disc heads, staples, or breaks in vapor barrier jacket with 4" wide woven glass fabric tape embedded in equivalent of Foster 30-80 vapor barrier, fire resistant adhesive. Do not use pressure sensitive tape.

3.04 PREPARATION

S. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.05 GENERAL INSTALLATION REQUIREMENTS

T. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

U. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

V. 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.

W. Install insulation with longitudinal seams at top and bottom of horizontal runs.

X. Install multiple layers of insulation with longitudinal and end seams staggered.

Y. Keep insulation materials dry during application and finishing.

Z. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

AA. Install insulation with least number of joints practical.
Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 "Penetration Firestopping" for firestopping and fire-resistant joint sealers.

Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 "Penetration Firestopping."

END OF SECTION
SECTION 23 07 19

HVAC EQUIPMENT AND PIPING INSULATION

PART 1  GENERAL

1.01  SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Chilled-water piping, indoors and outdoors.
   2. Heating hot-water piping, indoors.

B. Section includes insulating the following HVAC equipment that is not factory insulated:
   1. Boiler
   2. Chilled Water Pump
   3. Hot Water Heating Pump
   4. Expansion Tanks
   5. Air Separators

1.02  SUBMITTALS

A. Submit manufacturer's product data and installation procedures for review.

PART 2  PRODUCTS

2.01  PIPE AND EQUIPMENT INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Cellular Glass (Foamglass): Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Must have a minimum "R" value of 3.4 per inch at 75 degrees F mean temperature. Use Cellular Glass for the following:
   1. Exterior chilled water piping

C. Flexible Tubular Elastomeric:
   1. Provide fire-retardant closed-cell slip-on flexible type; minimum "R" value of 2.57
   2. Acceptable manufacturers: Armacell LLC or AP Armaflex
   3. Use on the following services:
      a. Moisture condensate drains - 1/2" thick
      b. Refrigerant suction and hot gas for split systems: 1" thick.

D. Flexible Sheet:
   1. Provide closed-cell flexible sheet type; minimum "R" value of 3.57
   2. Acceptable manufacturers: Armacell or AP Armaflex
   3. Use on the following services:
a. Chilled water pump casings and flanges: 1" thick
b. Chilled water piping valves, strainers and hydronic specialties: 1" thick
c. Air separators - 1-1/2" thick
d. Refrigeration machine cooler, suction piping and pipe connections: 1-1/2" thick.

E. Fiberglass Pipe Insulation:
2. Use on the following services:
   a. Chilled water piping - 2" and under: 1" thick; 2-1/2" and over: 1-1/2" thick
   b. Heating hot water piping, Runouts to terminal units (12 feet or less) 2" and less - 1/2" thick; 2-1/2" and greater - 1-1/2" thick.
   c. Drain bodies, traps and horizontal drain lines receiving cold condensate - 1/2" thick

2.02 MATERIALS FOR FITTINGS, VALVES, AND SPECIAL COVERINGS

A. For all services, use premolded insulation for pipe fittings, elbows, tees, valves, and couplings matching basic insulation. Pre-molded insulation fittings shall be equal to those manufactured by Hamfab. Pre-molded insulation fitting shall be finished with glass fabric and vapor barrier mastic. Glass fiber blanket inserts with plastic cover are not acceptable for pipe fitting insulation. Field mitering is acceptable for fittings 8" and larger. Valves, strainers, flanges, etc. shall be covered with mitered insulation segments of the same type and thickness as adjoining pipe insulation.

B. For tanks, heat exchangers and large pipes in systems operating over 60 degrees F when exposed-to-view inside building or in equipment rooms, cover insulation with a smoothing coat of Keane Powerhouse cement, one layer of white colored woven glass fabric embedded and finished with Foster GPM mastic.

C. For pipe fittings, valves, strainers, and other irregular surfaces, in chilled water or refrigerant systems operating below 60 degrees F, when inside building or in equipment rooms, cover insulation with white colored woven glass fabric embedded in white vapor barrier coating, Foster 30-35 or equal.

D. All mechanical pipe and fittings within 7'-0" of floors or work surfaces in mechanical rooms and outdoors shall be protected with 0.016" thick smooth, aluminum jacket using factory formed aluminum covers for fittings and valves and secured with self-tapping crews and drawbands. No corrugated jacket with be allowed. Install jacket seams on bottom of pipe.
E. For flexible tubular elastomeric pipe and fitting insulation when exposed-to-view inside building or exposed to the weather, finish with two coats of fire retardant self-extinguishing vinyl lacquer type highly flexible coating equivalent to Armstrong "Armaflex Finish", custom color blended to match surrounding surfaces.

**PART 3 EXECUTION**

3.01 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Adhesives, cements and mastics shall be compatible with materials applied and shall not attack materials in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.
K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
3.03 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 "Penetration Firestopping."

3.04 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors,
switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.05 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut
sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION
A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.08 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. Aluminum, Smooth: 0.016 inch thick.

3.09 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. Aluminum, Smooth: 0.016 inch thick.

3.10

A. Manual volume damper handles, airflow station pressure ports, access door handles, duct mounted instrumentation shall be left exposed or accessible above the insulation vapor barrier. Damper handles in externally wrapped ductwork shall be provided with stand-off brackets and locking quadrants to ensure the handle can be adjusted without disturbing the insulation vapor barrier.

END OF SECTION
PART 1  GENERAL

1.01 DESCRIPTION

A. The Direct Digital Control/Building Automation System (DDC/BAS) shall be Johnson Controls Metasys or approved equal.

B. Provide a complete control system including electrical interlocks, wiring, conduit, relays, switches, control transformers, and all devices required for a complete operational system.

C. The Control Contractor shall work in close cooperation with the TAB agency in calibrating all airflow and water flow stations and all duct and pipe mounted differential pressure sensor/transmitters.

1.02 SUBMITTALS

A. Product Data: For each type of product include the following:
   1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
   4. Installation, operation and maintenance instructions including factors effecting performance.
   5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
   6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
   7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.
   8. Schematic drawings for each controlled HVAC system indicating the following:
      a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
      b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
      c. A graphic showing location of control I/O in proper relationship to HVAC system.
d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.

e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.

f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.

g. Narrative sequence of operation.

h. Graphic sequence of operation, showing all inputs and output logical blocks.

B. System Description:

1. Full description of the existing DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.

2. Complete listing and description of each report, log and trend available for format and timing and events which initiate generation.

3. Design Submittal Schedule and design calculations for control valves and actuators.

a. Flow at Project design and minimum flow conditions.

b. Pressure-differential drop across valve at Project design flow condition.

c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.

d. Design and minimum control valve coefficient with corresponding valve position.

e. Maximum close-off pressure.

f. Leakage flow at maximum system pressure differential.

g. Torque required at worst case condition for sizing actuator.

h. Actuator selection indicating torque provided.

i. Actuator signal to control damper (on, close or modulate).

j. Actuator position on loss of power.

k. Actuator position on loss of control signal.

C. Product Certificates:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.

b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.

c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.

e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.

f. Backup copy of graphic files, programs, and database on electronic media such as DVDs.

g. List of recommended spare parts with part numbers and suppliers.

h. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

i. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.

j. Licenses, guarantees, and warranty documents.

k. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

l. Owner training materials.

1.04 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified 12 month warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.

2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

   a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.

4. Warranty Period: One year from date of Substantial Completion.

5. Replacing defective parts and components as required.

PART 2 PRODUCTS

2.01 DDC SYSTEM DESCRIPTION

A. Direct Digital Control/Building Automation Systems (DDC/BAS) shall be fully compatible with ETSU College of Medicine Campus Standard automation system and shall be Johnson Controls Metasys.

B. Web based, building automation system (BAS) incorporating direct digital control (DDC), energy management, and equipment monitoring and control.
2.02 NETWORK AUTOMATION ENGINES (NAE)

A. Network Automation Engine (NAE 45XX)

1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.

2. Automation network - The NAE shall reside on the automation network and shall support a subnet of system controllers.

3. User Interface - Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
   a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
   b. The NAE shall support a minimum of two (2) concurrent users.
   c. The web based user shall have the capability to access all system data through one NAE.
   d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
   e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
   f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
   g. Systems that support UI Graphics from a central database or required the graphics to reside on the user's personal computer are not acceptable.
   h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
      1) Configuration
      2) Commissioning
      3) Data Archiving
      4) Monitoring
      5) Commanding
      6) System Diagnostics
   i. Systems that require workstation software or modified web browsers are not acceptable.
   j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor - The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

5. Memory - Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock - The NAE shall include an integrated, hardware-Based, real-time clock.

7. The NAE shall include troubleshooting LED indicators to identify the following conditions:
   a. Power - On/Off
   b. Ethernet Traffic - Ethernet Traffic/No Ethernet Traffic
   c. Ethernet Connection Speed - 10 Mbps/100 Mbps
   d. FC Bus - Normal Communications/No Field Communications
   e. Peer Communication - Data Traffic Between NAE Devices
   f. Run - NAE Running/NAE In Startup/NAE Shutting Down/Software Not Running
   g. Bat Fault - Battery Defective, Data Protection Battery Not Installed
   h. Fault - General Fault
   i. Modem RX - NAE Modem Receiving Data
   j. Modem TX - NAE Modem Transmitting Data

8. Communications Ports - The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator’s terminals.
   a. USC port
   b. URS-232 serial data communication port
   c. RS-485 port
   d. Ethernet port

9. Diagnostics - The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

10. Power Failure - In the event of the loss of normal power, the NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification - The NAE shall be listed by Underwriters Laboratories (UL).

12. Controller network - the NAE shall support the following communication protocols on the controller network:
    a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
       1) A BACnet Protocol Implementation Conformance Statement shall be provided for each controller
device (master or slave) that will communicate on the BACnet MS/TP Bus.

2) The Conformance Statements shall be submitted 10 days prior to bidding.

3) The NAE shall support a minimum of 50 control devices.

b. The NAE shall support LonWorks enabled devices using the Free Topology Transceiver FTT 10.
   1) All LonWorks control devices shall be LonMark certified.
   2) The NAE shall support a minimum of 64 LonWorks enabled control devices.

c. The NAE shall support the Johnson Controls N2 Field Bus.
   1) The NAE shall support a minimum of 50 N2 control devices.
   2) The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
   3) The Bus shall employ a master/slave protocol where the NAE is the master.
   4) The Bus shall employ a four (4) level priority system for polling frequency.
   5) The Bus shall be optically isolated from the NAE.
   6) The Bus shall support the Metasys Integrator System.

2.03 STAND-ALONG DDC PANELS

A. General: Stand-alone DDC panels shall be microprocessor based, multi-tasking, multi-user, real-time digital control processors. Each stand-alone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. Each DDC panel shall operate independently being performing its own specified control, alarm management operator I/O and historical data collection.

B. Memory: Each DDC panel shall have sufficient memory to support its own operating system and databases.

C. Point Types: Each DDC panel shall support the following types of point inputs and outputs:
   1. Digital Inputs for status/alarm contacts
   2. Digital Outputs for on/off equipment control
   3. Analog Inputs for temperature, pressure, humidity, flow, and position measurements
   4. Analog Outputs for valve and damper position control, and capacity control of primary equipment
   5. Pulse Inputs for pulsed contact monitoring

D. Integrated On-Line Diagnostics: Each DDC panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment.
E. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.

F. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of all stand-alone DDC panels to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours. Upon restoration of normal power, the DDC panel shall automatically resume full operation without manual intervention.

2.04 PERSONAL COMPUTER OPERATOR WORKSTATION (FACILITY OFFICE)

A. General: Provide an operator's workstation to access the BAS network.

B. Provide PC Compatible computer system configured for use with DDC system, Dell Inc. or approved equal with the following minimum features:
   1. Quad Core Intel® Core™ i7 920 processor
   2. 4.0 GB RAM memory
   3. 320 GB hard disk
   4. USB ports built-in
   5. DVD +/- RW 1-8X minimum CD-RW
   6. 22" LCD flat panel color monitor
   7. Microsoft USB mouse
   8. Microsoft Keyboard
   9. Software: Windows 7 Professional

C. Provide a color ink jet, multi-function, wireless printer, copier, fax and scanner equal to Lexmark S600. Printer shall print alarms, graphics and any other screen displays.

D. Network Connection: Graphical workstations shall allow for access to the BAS network through a pull-down menu approach using only a mouse. The keyboard shall be required only when entering text of for programming functions. The workstation shall be used as an interface to the BAS network and shall not be required to process any control or energy management algorithms nor manage any BAS network communications.

E. Provide context-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.

F. Multiple user security levels shall be provided to allow for various degrees of system access and control. The system shall automatically generate a report of log-on/log-off time and system activity for each user. Provide automatic log-off capability to prevent unauthorized system use.

G. The Workstation shall be provided with a key element display that records log-ons, log-offs, overrides, alarms and alarm acknowledgments.
2.05 SENSORS

A. BAS Sensors:

1. Provide sensors, controls, instruments, and control interfaces to meet the performance specified herein. Sensors shall be high quality precision electronic type, selected to be compatible with the BAS controllers and appropriate for the service specified herein. Accuracy values specified herein include sensor, wiring, signal conditioning and display accuracies for overall end-to-end performance. Sensors shall be selected to place the expected value in the middle third of the device's range.

2. Temperature sensors: 100 or 1000 ohm nickel resistance temperature device (RTD), Deutsche Industrial Norms (DIN) 43760, with an average percent change in resistance per degree (α) of 0.00385± 0.00002 ohms/ohm/°C, selected for normal range of media sensed with accuracy of ±0.5°F at 70°F except chilled water sensors used for Btu calculations shall have an accuracy of ±0.25°F at 32°F. Sensors used for Btu calculations shall be matched pairs at the calibration point. Temperature sensor stability errors shall not exceed 0.25°F cumulative over a 5 year period. Provide thermowells and insertion type sensors for water temperature sensing. Air temperature sensing shall be provided by duct insertion type sensors for supply or return duct temperatures and by extended element averaging type for plenum, and coil entering or leaving temperatures. RTD transmitters shall be a 2-wire, loop-powered device, producing a linear 4-20 mA output corresponding to the temperature span of the connected sensor. The output error shall not exceed 0.1% of calibrated span. Transmitters shall include noninteracting offset and span adjustments and RFI shielding and rejection circuitry to prevent disruption from ambient signals. Transmitter drift shall be less than 0.1°F per year.

3. Space temperature sensors: space temperature type with setpoint adjustment range of 45°F to 85°F. the setpoint adjustment shall be locked out, overridden, or limited as to time or temperature in software from a central or remote operator's terminal. Precisions thermistors may be used in space temperature sensing applications below 200°F. Sensor accuracy over the application range shall be minimum 0.5°F between the range of 32°F to 150°F including sensor error and A/D conversion resolution error. Sensor manufacturer shall utilize 100% screening to verify accuracy. Thermistors shall be pre-aged and inherently stable. Stability error of the thermistor over 5 years shall not exceed 0.25°F cumulative. Sensor element and leads shall be encapsulated. Bead thermistors shall not be used. Space temperature sensors shall include a communications port for local connection of a portable test/terminal device for communications/programming access to the associated BCS controller.

a. Covers:
1) Space temperature sensors shall have cover, visible temperature indicator integral to the sensor, and accessible means of setpoint adjustment.

4. Humidity sensors: bulk polymer type, with self-contained 4-20 mA transmitter and replaceable element. Accuracy shall be ±2% RH in the range of 20% to 90%. The transmitter shall include noninteracting zero and span adjustments with an output error not exceeding 0.1% of calibrated span. Saturation shall not alter calibration. Sensors for space humidity shall have same appearance as space temperature sensors.

5. Pressure transmitters: 2-wire strain gauge type, designed for media sensed for static pressure or differential pressure. The span shall be continuously adjustable from 0% to 125% of the expected full pressure of full flow differential pressure. The zero shall be continuously adjustable on outputs. Transmitters shall produce a 4-20 mA signal with an accuracy of ±1.0% of the upper range limit for 6 months from calibration. Instruments shall be capable of withstanding an overrange pressure limit of 300 normal.

6. Current sensing relays: current sensing relays shall provide an adjustable setpoint normally open contact rated at a minimum of 50 V peak and 0.5 A or 25 VA, noninductive. There shall be a single opening for passage of current carrying conductors. Relays shall be sized for operation at 50% rated current based on the connected load. Voltage isolation shall be a minimum of 600 V.

7. Filter status: filter status shall be sensed by digital pressure differential switches.

8. CO2 sensors: dual channel infrared type, with 10 micron filter to prevent particulate contamination of sensing element. Sensor shall have an accuracy of ±5% of reading up to 10000 ppm, with a repeatability of ±20 ppm and a maximum drift of ±10 ppm per year, and a recommended calibration interval of 5 years. Sensor shall have a response time of no more than 2 minutes to a 90% of full scale change. Sensor and transmitter shall provide a 4-20 mA analog output proportional to gas concentration.

2.06 MATERIALS

A. Actuators:
1. BAS terminal unit actuators: 24 V nonstall type, providing complete modulating control for the full range of damper movement. Actuators shall be de-energized when the damper has reached the operator or system determined position. Actuators shall be supplied to the terminal unit manufacturer for factory mounting and calibration. Actuators shall be removable for servicing without removing the terminal unit. Actuators shall be provided with transformers for proper operation from the terminal unit controller power source.

2. Other actuators: 24 V electric worm-gear type; sized to provide required starting torque and to control the drive apparatus smoothly. Higher voltage actuators are acceptable for specific applications where 24 V actuators are not adequate. Actuators shall have spring return.
B. Control valves: 2" and smaller, globe ball type with bronze bodies and screwed connections; over 2", globe type with cast iron bodies and flanged connections.
   1. Valves shall be capable of full closure against 150% of design pump head, or a 50 psig differential pressure, whichever is greater.
   2. Valves for water shall have equal percentage flow characteristics. Modulating control valves shall be sized for a pressure drop of 3 psig to 5 psig, unless indicated otherwise on the Drawings. Two-position valves shall be in line size.
   3. Valves for steam shall have linear flow characteristics. Steam valve sizes are indicated on the Drawings.
   4. Pressure/temperature rating: as specified in Section 23 10 00, "Piping, Valves and Accessories".
   5. At the Contractor's option, control valves may be butterfly type for chilled and condenser water service in piping 8" and larger. Modulating butterfly valves shall be sized for full flow pressure drop of 2 psig to 4 psig at 60% open and be limited to this opening. Two-position butterfly valves shall be line size. Valves shall be rated for bubbletight closure at a differential pressure equal to the valve body rating.

C. Control dampers: single-blade up to 8" high, multiblade over 8" high; minimum 80% free area based on damper frame outside dimensions.
   1. Blades: minimum 16 gauge galvanized steel, or extruded aluminum. Blades shall be airfoil shape.
      a. Pivot rods: steel, minimum 0.5" diameter or hex, with one rod extended 6" to permit operation of damper from outside the duct.
      b. Maximum length 42", maximum width 8".
      c. At points of contact: interlocking or overlapping edges, and compressible neoprene or extruded vinyl blade seals, and compressible metal side seals designed for temperature -40°F to 180°F at leakage rate specified herein.
      d. Type:
         1) Opposed blade: for balancing and modulating applications.
         2) Parallel blade: for 2-position, and outside and return air mixing applications. For mixing applications, orient dampers to achieve maximum mixing at throttled conditions.
      e. Maximum damper area per motor: 15ft².
   1. Leakage when closed: less than 4 cfm/ft² at 1" wg differential static pressure based on a 48" damper width.
   2. Frames: galvanized steel bar minimum 2" wide x 12 gauge for dampers 10" high or less, and 3.5" x 0.875", 16 gauge galvanized roll-formed channel with double-thickness edges or 5" x 1" x 0.125" extruded aluminum channel for 11" high and larger.
      a. Corner bracing.
      b. Full size of duct or opening in which installed.
a. Thrust bearings: vertically mounted.
b. Maximum spacing: 42”.
4. Finish on steel parts: galvanized.
5. Operating linkage: factory-assembled, concealed in frame out of airstream, steel construction.

D. Panels: Surface type cabinet with hinged front panel and cylinder lock. Panels shall utilize one master key.

E. Thermowells: monel, brass, or copper for use in water piping and stainless steel for other applications. Thermowells shall have threaded plug and chain, retaining nut, and lagging neck to clear insulation. Inside diameter of insertion neck shall accommodate the element being installed.

F. Weather shield enclosures: NEMA 3R rated with transparent cover, sized for the device enclosed.

G. Airflow measurement systems: provide complete UL listed assemblies to monitor airflow in ductwork at locations indicated on the Drawings. Each system shall be complete with one or more multipoint measuring probes, airflow sensors and a single microprocessor-based transmitter.
1. Probes: Aluminum or stainless steel construction with mounting brackets. Probes shall be supported at both ends.
2. Airflow sensors: Designed to operate at velocities of 50 fpm to 5000 fpm, temperatures of -20°F to 140°F, and relative humidities of 0% to 99% (noncondensing). Each sensing point shall independently determine the airflow rate which shall be equally weighted and averaged by the transmitter prior to output.
3. The minimum number of sensors for each assembly shall be as follows:

<table>
<thead>
<tr>
<th>Area, (ft²)</th>
<th>No. of Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 4</td>
<td>4</td>
</tr>
<tr>
<td>4 to 8</td>
<td>6</td>
</tr>
<tr>
<td>8 to 12</td>
<td>8</td>
</tr>
<tr>
<td>12 to 16</td>
<td>12</td>
</tr>
<tr>
<td>&gt; 16</td>
<td>16</td>
</tr>
</tbody>
</table>

4. Transmitters: Designed to operate at temperatures of -20°F to 120°F and provided with LCD display 24 V AC power connection, and analog output signal (0-10 V DC or 4-20 mA) for connection to the BCS.
5. Accuracy: ±2% of reading over the entire operating airflow range.

2.07 ELECTRONIC AND ELECTRIC CONTROL COMPONENTS

A. Electric Thermostats: Thermostats to be manufacturer's best commercial grade thermostat with adjustable setpoint, dials calibrated in degrees F. Select thermostats with suitable range for service intended. Provide each thermostat with locking metal cover. Thermostat shall be equal to Johnson Controls TE-67NP-2N00.
B. Electronic Sensors/Transmitters: Sensors/transmitters to be 1000 Ohm platinum RTD type with high resistance change vs. temperature or humidity change, accurate to +/- 0.3 degrees F for temperature and +/- 2.0% for humidity at applicable range, and provide 4 to 20 MA or 0 to 5 VDC output signal. Sensors/transmitters to be suitable for room, duct, or well mounting as required by application. Room type to have built-in setpoint potentiometer and digital room temperature/humidity indication. Select for temperature/humidity range of application. Provide appropriate mounting plate and hardware. Temperature sensors used as a part of Energy (BTU) Measurement System shall meet the applicable requirements of that section.

C. Freezestats (Low Limit Binary Type): Provide single, custom length Freon-filled capillary tube type with sensing element actuated by temperature on any one foot portion. Sensor shall be a single element with length of one linear foot for every one square foot of coil face area. Freezestats to be UL approved, manual reset type.

D. Control Panels: Control panels to be constructed of unitized steel or aluminum cabinets. Provide cabinets with hinged, locking door opening to the front. Multiple panels mounted side-by-side to be hinged to the left or on opposite sides to open in the middle. Start-stop switches, hand-off-automatic switches, pilot lights, and temperature indicating devices to be flush-mounted in panel door. All other devices to be internally mounted within panel. Local panels exposed to weather to be weatherproof construction. Panel locations to be approved by Designer and be accessible for operation and maintenance. All lines in panel shall have number I.D. bands. All devices inside the panel or mounted on panel face shall have an engraved laminated plastic nameplate. Wiring within panel to conform to National Electrical Code, and shall be neatly bundled and laced or enclosed in conduit trough.

E. Transformers: Provide all 24-volt control transformers necessary to convert 120-volt line voltage power to control voltage at control devices.

F. Relays, Hand-Off-Auto Switches, Pilot Lights: Provide all relays, hand-off-auto switches, and pilot lights necessary to accomplish automatic control of the mechanical systems. See electrical drawings for starters provided integral with hand-off-autos, pilot lights, and auxiliary contacts.

G. Pressure Switches: Pressure switches shall have contact action and pole configuration as required by application, U.L. listing, and adjustable setpoint.

2.08 AIR FLOW MEASURING STATION

A. Multi-point electronic thermistor probe suitable for duct or fan inlet airflow measurement with transmitter, equal to Ebtron Advantage II Gold Series. Provide aluminum alloy casing, ± 2% / ± .25% accuracy/repeatability and UL listed transmitter.

2.09 PRESSURE TRANSMITTERS/TURSDUCERS:
A. Acceptable Manufacturers:
   1. Setra Systems, Inc.

B. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
   1. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   2. Output: 4 to 20 mA.
   3. Building Static-Pressure Range: 0- to 0.25-inch wg.
   4. Duct Static-Pressure Range: 0- to 5-inch wg.

C. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.

D. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and testing to 300-psig; linear output 4 to 20 mA.

E. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

F. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.10 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

A. Each stand-alone DDC controller 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. Each ASC shall have sufficient memory to support its own operating system and data bases.

D. The operator interface to any ASC point data or programs shall be through any network-resident PC workstation or portable operator's terminal connected to any DDC panel in the network.

E. Application specific controllers shall directly support the temporary use of a portable service terminal.

F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.

G. The modes of operation supported by each ASC shall minimally include, but not be limited to, the following:
   1. Daily/Weekly Schedules
2. Occupancy Mode
3. Economy Mode.
4. Temporary override Mode

H. Continuous Zone Temperature Histories: Each ASC shall automatically and continuously maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.

I. Alarm Management: Each ASC shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

J. Application Descriptions:
   1. VAV Terminal Unit Controllers:
      a. VAV terminal unit controllers shall support, but not be limited to, the control of the following configurations of VAV boxes to address current requirements as described in the Execution portion of this specification, and for future expansion.
         1) Single Duct (Cooling Only or Cooling With Reheat)
      b. VAV terminal unit controllers shall support the following types of point inputs and outputs:
         1) Proportional Cooling Outputs
         2) Heating Outputs
      c. Each VAV terminal unit shall be provided with a thermostat with numerical temperature setpoint adjustment with scales graduated in degrees F.

   2. AHU Controllers:
      a. AHU controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally stand-alone fashion.
      b. AHU controllers shall have a library of control routines and program logic to perform the sequence of operation.

2.11 DDC CONTROLLERS

A. The DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.
E. **Environment Requirements:**
   1. Controller hardware shall be suitable for the anticipated ambient conditions.

F. **Power and Noise Immunity:**
   1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
   2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. **DDC Controller Spare Processing Capacity:**
   1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
      a. Network Controllers: 50 percent.
      b. Programmable Application Controllers: Not less than 60 percent.
      c. Application-Specific Controllers: Not less than 80 percent.
   2. Memory shall support DDC controller’s operating system and database and shall include the following:
      a. Monitoring and control.
      b. Energy management, operation and optimization applications.
      c. Alarm management.
      d. Historical trend data of all connected I/O points.
      e. Maintenance applications.
      f. Operator interfaces.
      g. Monitoring of manual overrides.

H. **Input and Output Point Interface:**
   1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
   2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
   3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.

2.12 **PROGRAMMABLE APPLICATION CONTROLLERS**

A. **General Programmable Application Controller Requirements:**
   1. Include adequate number of controllers to achieve performance indicated.
   2. Controller shall have enough memory to support its operating system, database, and programming requirements.
   3. Data shall be shared between networked controllers and other network devices.
   4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers that perform scheduling shall have a real-time clock.

6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.

7. Controllers shall be fully programmable.

B. Communication:
1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:
1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.

D. Serviceability:
1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.13 DYNAMIC COLOR GRAPHICS

A. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.

B. The graphics applications shall include a create/edit function and runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.

C. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.

D. Graphics runtime functions - A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
1. All graphics shall be fully scalable.
2. The graphics shall support a maintained aspect ratio.
3. Multiple fonts shall be supported.
4. Unique background shall be assignable on a per graphic basis.
5. The color of all animations and values on displays shall indicate if the status of the object attribute.

E. Operation from graphics - It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device.
F. Graphic editing tool - A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.

1. The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.

2. In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.

G. Aliasing - Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

2.14 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.

2. Transformer shall be at least 40 VA.

3. Transformer shall have both primary and secondary fuses.

B. DC Power Supply:

1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.

2. Enclose circuitry in a housing.

3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.

4. Performance:

a. Output voltage nominally 25-V dc within 5 percent.

b. Output current up to 100 mA.

c. Input voltage nominally 120-V ac, 60 Hz.

d. Load regulation within 0.5 percent from zero- to 100-mA load.

e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.

f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.
C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop penetrations made in fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."

H. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

I. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

3.02 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, cabinets, building wire and cable according to Division 26.
   1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   2. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   3. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   4. Number-code and color-code conductors for future identification and service of control system, except local individual room control cables.
   5. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

3.03 FINAL REVIEW

A. Submit written request to Architect and Construction Manager when DDC system is ready for final review. Written request shall state the following:
1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Review by Architect and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
D. Prepare and submit closeout submittals when no deficiencies are reported.
E. A part of DDC system final review shall include a demonstration to parties participating in final review.
1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:
   a. Accuracy and calibration of 20 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
   b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 20 I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.
   c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
   d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
   e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
   f. Trends, summaries, logs and reports set-up for Project.
   g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of...
operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.

h. Software’s ability to communicate with controllers, operator workstations, uploading and downloading of control programs.

i. Software’s ability to edit control programs off-line.

j. Data entry to show Project-specific customizing capability including parameter changes.

k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.

l. Execution of digital and analog commands in graphic mode.

m. Spreadsheet and curve plot software and its integration with database.

n. Online user guide and help functions.

o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.

p. System speed of response compared to requirements indicated.

q. For Each Programmable Application Controller:
   1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
   2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and PDA. Show that maintenance personnel interface tools perform as indicated in manufacturer’s technical literature.
   3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
   4) Electric Power: Ability to disconnect any controller safely from its power source.
   5) Wiring Labels: Match control drawings.
   6) Network Communication: Ability to locate a controller’s location on network and communication architecture matches Shop Drawings.
   7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.

r. For Existing Operator Workstation:
   1) I/O points lists agree with naming conventions.
   2) Graphics are complete.
   3) UPS unit, if applicable, operates.

3.04 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to
suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:
   1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
   2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.

3. Minimum Training Requirements: Provide not less than one day of training.

C. Training Schedule:
   1. Training shall occur within normal business hours at a mutually agreed on time.

D. Attendee Training Manuals:
   1. Provide each attendee with a color hard copy of all training materials and visual presentations.
   2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
   3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

END OF SECTION
PART 1 GENERAL

1.01 GENERAL

A. Submit pipe and fitting. Work shall not start until approval. Pipe, fittings, weights, working pressure and classification shall be clearly marked.

PART 2 PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Hard-Drawn Seamless Copper Tubing: ASTM B 88, Type L (ASTM B 88M). Elbows are to be long radius pattern. Solder shall be 95-5 type. "Tee pullers" shall not be used in place of tees on copper piping.
1. Heating hot water supply and return piping 2" and smaller.
2. Chilled water supply and return piping 2" and smaller.

B. Copper Pipe Fittings: ASTM B-62, dimensions conforming to ANSI B16.22, wrought copper, with sweep patterns for copper tubing. Provide dielectric couplers at junction of steel pipe and copper piping systems.

C. DWV Copper Tubing: ASTM B 306, Type DWV for above ground moisture condensate drain piping.

D. Unions to be brass ground joint, 250-pound working pressure.

E. Nipples used in conjunction with copper pipe to be brass.

2.02 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A-53, black steel, Schedule 40 with welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
1. Heating hot water supply and return piping 2-1/2" and larger.
2. Chilled water supply and return piping 2-1/2" and larger.

B. Piping 2-1/2" and larger shall be seamless black steel, Schedule 40, ASTM A-53, Gr. B, or A106 with welded or flanged fittings, ANSI B16.9. ERW piping may be considered. Elbows are to be long radius pattern. Field-fabricated fittings are not acceptable. Forged steel, gasketed flanges, ANSI B16.5, of the welded neck type are to be used at flanged connections. Slip-on type may be used on straight pipe. Flanges must be compatible with valve and equipment connections. Where a branch connection from a main or header is one half the main diameter or smaller, saddle-type, forged steel welding fittings may be used.
C. Welding shall conform to ANSI Code for Pressure Piping, Section B31.1. All welds shall be of the single "V" butt joint type with optimum fusions and 100% weld penetration of wall thickness. Piping should be welded by the shielded arc type electrode-electric arc process. Butt joints should be made with split backing rings. In most cases, direct welded connections shall not be made to valves, strainers, equipment, etc. The contractor should be required to obtain certification of all pipe welders on the project, in accordance with Section IX of the ASME code.

D. Union or flanged connections should be provided at valves, equipment, etc. Provide dielectric unions at the junction of steel pipe and equipment with copper piping systems. Or, preferably, provide steel to brass to copper connections. Where size changes on horizontal lines, use reducing fittings having eccentricity down, top level. All piping take-offs should be made from the top of mains or headers. Do not "bullhead" tee connections.

2.03 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

A. Makeup-water piping shall be the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Makeup-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

C. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

E. Air-Vent Piping:
   1. Provide manual air vents at high points of vertical risers and at each water coil.
   2. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
   3. Outlet: Type K (Type A), annealed-temper copper tubing with soldered or flared joints.
3.02 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 232116.
Q. Install unions in piping, 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."

X. Do not use bullhead tees.

3.03 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for 2-1/2 to NPS 4: Use dielectric flange kits.

D. Dielectric Fittings for 6 and Larger: Use dielectric flange kits.

3.04 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. 3/4: Maximum span, 7 feet.
2. 1: Maximum span, 7 feet.
3. 1-1/2: Maximum span, 9 feet.
4. 2: Maximum span, 10 feet.
5. 2-1/2: Maximum span, 11 feet.
6. 3 and Larger: Maximum span, 12 feet.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at each floor.

3.05 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.06 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections. Reference floor plans for pipe sizes.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections.

3.07 WATER DRAINING

A. Provide 3/4" hose end gate valves at low points and bottom of each riser to drain HVAC water systems.

3.08 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as chillers and heat exchangers to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION
SECTION 23 21 14

EXTERIOR AND UNDERGROUND CHILLED WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.01 APPLICABLE STANDARDS:
The standards listed herein by society name, codes, etc. form a part of this specification to the extent referenced. The publications of such references are referred to in the text by the basic designation only, i.e., ASTM, ASME, etc.

1.02 SCOPE:
Provide a completely operational prefabricated and pre-insulated underground distribution system for chilled water supply and return as shown on the drawings and specified herein. The work shall include but not be limited to the following:

A. The Contractor shall be responsible for field verification and site surveying required for determining exact dimensions for ordering materials and completing the installation.

B. Submittal of technical product data, installation instructions, certifications and shop drawings as required herein.

C. Manufacture of the system in strict accordance with quality control and testing requirements as specified herein.

D. Shipment, handling, storage and installation of the system in strict accordance with manufacturers’ instructions and requirements as specified herein.

E. Coordination with all other trades in the installation of this and other work associated with the project.

F. Provision of accessories, valves, specialties, seals, materials, labor and equipment required for a complete and operational system installation in accordance with Contract.

G. Testing, repair or replacement of defective materials or work, retesting to meet the test requirements of this section.

H. Excavation, dewatering, shoring, backfill and compaction as specified herein, and in accordance with manufacturers’ instructions and job site requirements.
1.03 APPROVED MANUFACTURERS:
Basis of design is Rovanaco Insul-8 steel carrier pipe with HDPE jacket.

A. Alternate approved manufacturer is Perma-Pipe XTRU-Therm. All requirements specified herein must be met by the system provided.

B. Substitutions of insulation materials, jacket materials, carrier pipe types and schedules shall not be permitted. Changes in pipe routing shown on the drawings shall not be permitted. Specified insulation thickness and jacket thicknesses shall be minimum permitted.

C. Only systems meeting the requirements of this section and listed under approved manufacturer’s paragraph will be accepted.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data, installation instructions and details, and Field Service Technician’s qualifications.

B. Shop Drawings: Submit scaled layout drawings of the systems, including details of all components, fittings, expansion/contraction compensation, end seals, and anchors. Drawings shall clearly indicate pipe sizes, jacket sizes, slopes of horizontal runs, trench cross section details, and wall or floor penetration details. All dimensions shall be field verified prior to manufacturer of the system.

C. Record Drawings: Included installation details in the project Record Drawings upon completion of installation. Record Drawings shall reflect actual installed conditions of the systems in plan and elevations and shall accurately locate all system components.

D. Maintenance Data: Submit maintenance data for systems provided. Included this date with product, shop drawings, record drawings in an Owner’s maintenance manual.

PART 2 PRODUCTS

2.01 GENERAL:
The underground chilled water distribution system shall be a factory prefabricated and pre-insulated system consisting of carrier pipe, insulation and jacketing as specified, and supplied by an approved manufacturer listed herein.

2.02
System shall be designed for working pressures up to 150 psig and working temperature of 40° F, and shall meet the following requirements:

A. Carrier pipes shall be black steel, ASTM A53, Grade B, seamless, schedule 40 for sizes through 10” diameter; 0.375 inch wall thickness for sizes 12” and larger diameter.

B. Carrier pipe fittings shall be wrought steel, weld type, long radius, and shall match thickness of adjacent pipe. For pipe sizes less than 2.5” diameter, fittings shall be socket welded. For pipe sizes 2.5” and larger fittings shall be butt welded.

C. Insulation for pipe and fittings shall be polyurethane foam with the following characteristics: K factor of not greater than .15 at 50 degree F ambient temperature, minimum density of not less than 2 pounds per cubic foot, in conformance with MIL-I-24172, completely filling the annular space between carrier pipe and jacketing. Minimum insulation thickness will be in accordance with the following table.

D. Jacketing for all pipe and fittings shall be seamless, high density polyethylene (HDPE), conforming to ASTM D1248 and D3350, type III, category 5, Class C and grade P23/P34. Minimum jacket thicknesses and diameters shall be in accordance with the following schedule:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>INSULATION THICKNESS</th>
<th>JACKET THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 in. and below</td>
<td>1.0 in.</td>
<td>.125 in.</td>
</tr>
<tr>
<td>6 in. thru 10 in.</td>
<td>2.0 in.</td>
<td>.150 in.</td>
</tr>
<tr>
<td>12 in thru 18 in.</td>
<td>2.0 in.</td>
<td>.200 in.</td>
</tr>
</tbody>
</table>

E. All fittings shall be factory prefabricated and pre-insulated at manufacturers’ plant. No insulation of fittings will be allowed on the job site. All factory fabricated jacket joints and miters for elbows, tees, anchors and accessories shall be HDPE butt fusion welded. The factory HDPE welding procedure and quality control method shall be submitted with product data submittals for approval.

F. After welding and testing of carrier pipes, field joint area shall be insulated with sectional urethane foam. No mixing, pouring or spraying of foam insulation shall be allowed at field joints. Sectional urethane foam insulated field joint shall be covered with a split HDPE rock shield of same thickness as adjacent jackets and the entire joint area covered with a polyethylene heat shrink cover, minimum 60 mils thickness.
G. End seals will be provided at all terminations of the pre-insulated system. End seals shall be pre-molded polyethylene shrink type.

**PART 3 EXECUTION**

3.01 GENERAL: Installation of the prefabricated, pre-insulated systems shall be done in accordance with the following requirements and the manufacturer’s instructions.

3.02 EARTHWORK

A. Provide excavation, dewatering, backfilling, and shoring under this section. Comply with all local codes and safety ordinances related to this work.

B. Excavate trenches to the depths as indicated on the drawings, making allowance for 6” of bedding material. Grade the bottom of the trench to provide uniform beaming and support for the pipe. Remove shoring, bracing, support blocks and debris from the trench. Install a 6” layer of sand bedding material and hand compact to 90% modified proctor.

C. After placement of pipe back fill with sand or an approved sand-gravel mixture in 6” lifts to a distance of 12” above the top of the pipe casting or jacket. Hand compact each layer.

D. Place final backfill in one foot lifts. Final backfill material to be clean earth free of organic material, rocks, and foreign matter. Final backfill may be compacted using mechanical compaction equipment to 85% modified proctor.

E. Maintain minimum cover of 24” above top of pipe casting in grassed areas and 36” in paved areas and below sidewalks.

3.03 RECONDITIONING SURFACES

A. Unpaved surfaces shall be restored to their original condition and elevation. Sod or topsoil shall be carefully preserved and replaced after backfilling. Sod that is damaged shall be replaced.

B. Paved surfaces, sidewalks, gutters and curbs shall be patched or restored to an undisturbed condition.

3.04 WELDING: The contractor shall be solely and entirely responsible for the quality of system welding.
A. Qualification of welders, rules of procedure for qualification, and general requirements for fusion welding shall conform to applicable portions of ANSI 31.1 and AWS B3.0. All welds shall have 100% penetration. Each welder shall be examined at the job site by the Contractor to determine the ability of the welder to meet the qualifications required. The Contractor shall have available for review a listing of qualified welder’s names and corresponding code markings.

B. Field beveling and factory beveling may be by mechanical means or flame cut. For flame cut bevels, thoroughly clean surfaces of scale and oxidation just prior to welding. All beveling shall conform to ANSI B31.1 and AWS B3.0.

C. Use split welding rings for field joints on all pipe 2.5” and larger to assure proper alignment, complete penetration, and prevention of weld splatter reaching the interior of pipe. Make field joints for pipe less than 2.5” using welding sockets.

D. Test all welds in accordance with provisions of this section. Replace and re-inspect defective welds. Repairing defective welds by adding weld material over defect or by peening shall not be permitted.

E. Store electrodes in a heated dry area and keep free from moisture during fabrication operations.

F. For factory fabrications, all steel pipe and fittings shall be welded and tested in accordance with ANSI B31.1 Code for Pressure Piping. All steel pipe welders at the prefabrication plant shall be certified. Steel pipe welding procedures and certifications of welders are to be submitted with product data submittals.

3.05 TESTING

A. Carrier pipes shall be hydrostatically tested at 1.5 times working pressures or at 150 psig, whichever is greater, for a period of four hours. Visually inspect all joints for signs of leakage. Systems may be tested in stages, but every weld joint shall be tested.

B. Additionally, where piping crosses traffic thoroughfares and other areas subject to frequent vehicular or equipment loads, perform radiography for all field welds.

C. Designer shall be notified 48 hours prior to any test. Contractor shall submit test reports on every test indicating date of test, sections tested,
beginning and ending times and beginning and ending pressures recorded.

END OF SECTION
PART 1 GENERAL

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Hot-Water Heating Piping: 125 psig at 200 deg F.
   2. Chilled-Water Piping: 125 psig at 200 deg F.
   3. Makeup-Water Piping: 80 psig at 150 deg F.
   4. Condensate-Drain Piping: 150 deg F.
   5. Air-Vent Piping: 200 deg F.
   6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.02 VALVES

A. Ball Valves
   1. HVAC Circulating Water Piping: 2" and less Figure T-585-70 or S-585-70, 2-piece, full port, 600 psi, WOG, TFE seats.
   2. Provide ball valves with locking handle.
   3. Provide extended lever for insulated service.
   4. Stainless Steel balls to be used.

B. Butterfly Valves - 2-1/2" And Up:
   1. HVAC Circulating Water Piping: Figure LD-2000, lug type, 200 psi, Class 125, EPDM liner, aluminum bronze disc.
   2. Butterfly valves rated bubble tight for dead end service at full pressure in both directions without the need for downstream blind flange.
   3. Provide hand wheel and closed housing worm gear on valves 8 inches and larger. Provide clamp lock hand lever operators on valves less than 8 inches.

C. Check Valves:
   1. HVAC Circulating Water Piping:
      a. System pressures 125 psi and less: Figure 910, non slam.

D. Control Valves:
   1. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230923 "Direct Digital Control (DDC) System for HVAC.

E. Balancing Valves: Bronze, Calibrated-Orifice
   1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
2. Ball: Brass or stainless steel.
3. Plug: Resin.
4. Seat: PTFE.
5. End Connections: Threaded or socket.
7. Handle Style: Lever, with memory stop to retain set position.
8. CWP Rating: Minimum 125 psig.
9. Maximum Operating Temperature: 250 deg F.

F. Pressure-Reducing Valves: ASME labeled, Diaphragm-Operated
2. Disc: Glass and carbon-filled PTFE.
5. Diaphragm: EPT.
6. Low inlet-pressure check valve.
7. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Safety Valves: ASME labeled.
1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
5. Diaphragm: EPT.
7. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Flow Balancing Valve
1. Type: Similar to B & G "Circuit Sentry", Armstrong "CBV" or Taco "AccuFlow".
2. Provide calibrated, non-ferrous valve with provisions for connecting a portable differential pressure meter for flow measurement and balance.
3. Provide meter connections with built-in check valves.
4. Provide integral pointer to register degree of valve opening with tamper proof memory feature.
5. Provide valve with drain connection.
6. Construct valve with integral seals to prevent leakage around rotating element.
7. Construct valve for 125 psi working pressure at 150 degrees F.
8. Provide preformed polyurethane insulation for easy access to valve without disturbing field applied adjacent insulation.
9. Provide valve with engraved tag attached indicated design flow, pressure, and flow characteristic of station.

2.03 ELECTROMAGNETIC FLOW METER

A. Insertion style electromagnetic flow meter equal to Onicon F-3500 Series.

2.04 AIR-CONTROL DEVICES

A. Manual Air Vents:
   1. Body: Bronze.
   2. Internal Parts: Nonferrous.
   3. Operator: Screwdriver or thumbscrew.
   4. Inlet Connection: NPS 1/2.
   7. Maximum Operating Temperature: 225 deg F.

B. Expansion Tanks:
   1. Expansion tanks shall be bladder type, welded steel, designed, constructed, certified and stamped in accordance with ASME BPVC-VIII-1-2013 for a working pressure of 125 psig at 240°F. Bladders shall be replaceable elastomeric butyl rubber type.
   2. Manufacturers: Bell & Gossett, Flo-Fab.

C. In-Line Air Separators:
   1. Centrifugal inline tank type, capable of handling the water flow indicated on the drawings and constructed for 125 psig working pressure.
   2. Manufacturer: Bell & Gossett, Flo-Fab.

2.05 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

B. Stainless-Steel Bellow, Flexible Connectors:
   2. End Connections: Threaded or flanged to match equipment connected.
   4. CWP Rating: 150 psig.
   5. Maximum Operating Temperature: 250 deg F.
C. P.T. Test Plugs:
1. Provide 1/4 inch solid brass pressure/temperature test plugs at locations shown on drawings.
2. Nordel self-closing valve to be rated for 275 degrees F. service.
3. Plugs to be manufactured by Flow Design, Peterson Engineering, SISCO, or equal.

D. Pressure/Temperature Test Kit:
1. Provide Owner complete portable pressure and temperature test kit.
2. Kit to be complete with pressure test gauge, necessary connector hoses, temperature test thermometer with adapter, shutoff and vent valves and carrying case.
3. Readout kit to be manufactured by Bell & Gossett ITT or equal.

E. Pressure Gauges:
1. Provide 4-1/2 inch dial, liquid filled pressure gauges at locations shown on drawings.
2. Gauges to be equal to Trerice Model No. 500X with glycerin liquid fill, nylon, steel, or aluminum case, acrylic plastic window, brass movement, phosphor bronze bourdon tube, and brass socket.
3. Accuracy to be guaranteed within one-half percent.
4. Select scale range of gauges to indicate design pressure near midpoint of scale.
5. Provide each gauge with 1/4 inch size, brass construction needle valve equal to Trerice Model No. 735-2.
6. Provide each gauge with impulse dampener equal to Trerice Model No. 870.

F. Thermometers:
1. Provide Trerice or equal 9-inch scale, adjustable angle (rear, front, and side), industrial thermometers at locations shown on drawings.
2. Each thermometer to have aluminum case, clear acrylic plastic window, mercury tubing, scale with white background and black markings, brass stem, and separable brass well with 2-1/2" extension neck.

G. Thermometer Wells:
1. Provide Trerice or equal stainless steel thermometer wells for water temperature sensors and at other locations shown on drawings.
2. Test wells to be stainless steel with 2-1/2 inch extension neck and screw plug cap with chain and shall be filled with light clear oil.

2.06 BYPASS CHEMICAL FEEDER - CHILLED AND HOT WATER SYSTEM

A. Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves equal to Dearborn Type AV. Feeder shall be complete with 3/2" fill opening with 1/4 turn quick opening cover that cannot be removed while feeder is pressurized.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

**PART 3 EXECUTION**

**3.01 VALVE APPLICATIONS**

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

**3.02 HYDRONIC SPECIALTIES INSTALLATION**

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install piping from air separator to expansion tank with a 2 percent upward slope toward tank.

C. Install in-line air separators in pump suction. Install drain valve on air separators 2" and larger.

D. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
E. Install expansion tank on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

F. Chemical Treatment: Install complete systems in accordance with manufacturer's installation instructions. Provide all piping and tubing materials for interconnection of components.

END OF SECTION
SECTION 23 21 23

HYDRONIC PUMPS

PART 1  GENERAL

1.01  GENERAL

A. Pump manufacturer shall furnish and be responsible for the selection, compatibility and performance of each unit consisting of pump, motor, coupling and base plate.

B. Motor horsepower indicated on schedule is selected to allow non-overloading operation of pump. Pumps shall not be selected requiring impeller sizes within 10 percent of maximum impeller size for that pump size and/or have an efficiency of 75 percent or less.

PART 2  PRODUCTS

2.01  END-SUCTION CENTRIFUGAL PUMPS

A. Provide Bell & Gossett Series 1510 or Flo Fab Series 2000.

B. Description: Factory-assembled, non-overloading, single stage, end suction, horizontally frame-mounted, flexible coupled, bronze fitted, centrifugal type pump.

C. Pump Construction:
   1. Casing: Radially split, back-pullout-design, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
   2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
   4. In "Mechanical Seal" Subparagraph below, retain "Buna-N" option for temperature rating of 225 deg F; retain "EPT" option for 250 deg F.
   5. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
   7. Mount pump volute solidly to base through a pedestal support.
   8. Provide motor rated for inverter duty used for systems with variable frequency drives.

D. Coupling and Base Plate
   1. Manufacturer to furnish and mount pump and motor on common steel base plate with drip pan and drain connection.
2. Manufacturer to furnish and mount flexible coupling. Fasten metal coupling guard to pump base plate.

3. NAMEPLATE: Provide pump and motor with stainless steel or aluminum nameplate securely fastened to casings. Nameplates to provide all data necessary for equipment identification and replacement.

E. Motor: Single speed and rigidly mounted to pump casing with integral pump support.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Motor Requirements for HVAC Equipment."

2.02 PUMP SPECIALTY FITTINGS

A. Suction Diffusers and Triple Duty Valves to be manufactured by Bell & Gossett ITT or Flo Fab.

B. Suction Diffuser:
   1. Angle pattern.
   2. 250-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
   3. Bronze startup and bronze or stainless-steel permanent strainers.
   4. Bronze or stainless-steel straightening vanes.
   5. Drain plug.
   6. Bottom blowdown connection, inlet gauge port and adjustable support foot to carry weight of suction piping.

C. Triple-Duty Valve:
   1. Angle or straight pattern.
   2. 250-psig pressure rating, cast-iron body, pump-discharge fitting.
   3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
   4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 EXECUTION

3.01 PUMP INSTALLATION

A. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

C. Equipment Mounting:
1. Install base-mounted pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03 "Cast-in-Place Concrete."

2. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration Isolation for HVAC."

3.02 ALIGNMENT

A. Perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.03 CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves and Specialties."

B. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Where installing piping adjacent to pump, allow space for service and maintenance.

D. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

E. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

F. Install triple-duty valve on discharge side of pumps.

G. Install suction diffuser and shutoff valve on suction side of pumps.

H. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

I. Provide one spare set of bearings and seals for each pump supplied.

J. Provide drip pans.

K. Install compound pressure gauges on pump suction and discharge. Reference detail on drawings.
END OF SECTION
SECTION 23 31 13

SHEET METAL DUCTWORK - LOW PRESSURE

PART 1 GENERAL

1.01 DUCTWORK

A. Low pressure ductwork refers to systems operating at 2.0" w.g. total static pressure with velocities up to 2000 FPM.

B. Provide and/or construct all materials, ductwork, joints, transitions, dampers, access doors, etc., as set forth in these specifications necessary to install the low pressure sheet metal ductwork required by the Mechanical Drawings.

C. Seal all duct openings with plastic during construction. Protect the return/negative pressure side of ductwork system throughout the entire construction period.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with the latest edition of SMACNA "HVAC Duct Construction Standards," (Metal and Flexible) and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA "HVAC Duct Construction Standards" (Metal and Flexible).

PART 2 PRODUCTS

2.01 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA "HVAC Duct Construction Standards" (Metal and Flexible) based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct/Longitudinal Seams," for static-pressure class,
applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturer: Eastern Sheet Metal, SEMCO.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows shall be smooth radius with a centerline radius of 1.5 times the duct diameter.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "90 Degree Tees and Laterals," and "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 Duct Access Doors

A. Provide insulated, factory fabricated access doors with dual latches and gaskets along perimeter. Door shall match leakage and pressure class ratings of duct where door is located.
2.04 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.05 JOINT SEALER

A. Manufacturer by Hardcast Inc., Two Stage Sealant Process.
   1. Stage 1: Apply fiber DT tape.
   2. Stage 2: Brush on RTA-50 sealant over fiber tape.

2.06 GASKETS AND SEALS

A. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

B. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.07 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:
   2. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Seal all low pressure transverse and longitudinal joints with approved sealer in accordance with manufacturer's recommendation instructions.

D. Install round ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233713 "Sheet Metal Specialties" for fire and smoke dampers.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.07 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:
   1. Ducts Connected Downstream from Terminal Units:
      a. Pressure Class: Positive 2-inch wg.
   2. Ducts Connected to Single Zone-Volume Air-Handling Units:
      a. Pressure Class: Positive 2.5-inch wg.
   3. Ducts Connected Variable-Air-Volume Terminal Units:
      a. Pressure Class: Positive 2-inch wg.

C. Return/Exhaust Ducts:
   1. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 2-inch wg,

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 1-inch wg.
E. Outdoor-Air Ducts:
1. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg.

F. Intermediate Reinforcement:

G. Elbow Configuration:
1. Rectangular Duct: Elbows shall be smooth radius with a centerline radius of 1.5 times the duct diameter.

H. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

I. Side Takeoff Fittings:
1. Minimum 26 gauge: galvanized steel, designed for minimum pressure drop by an expansion from a rectangular connection to a round duct. The fitting shall include a 1" wide mounting flange with die formed corner clips, prepunched mounting holes, and an adhesive-coated flange gasket. The outlet collar shall be crimped and incorporate a bead.
2. Manufacturer: Crown, of Flexmaster.

END OF SECTION
PART 1 GENERAL

1.01 DUCTWORK

A. Medium pressure ductwork refers to systems with velocities greater than 2000 fpm operating at a static pressure of 6" or less, but greater than 2" wg.

B. The contractor shall provide and/or construct all materials, ductwork, joints, transformations, fittings, access doors, etc., as set forth in these specifications necessary to install the medium pressure sheet metal ductwork required by the drawings.

C. Seal all duct openings with plastic during construction.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

PART 2 PRODUCTS

2.01 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards".

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards", "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other
provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 ROUND AND FLAT OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
   1. Manufacturer: Eastern Sheet Metal, SEMCO.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards" for static class.
   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows shall be smooth radius with a centerline radius of 1.5 times the duct diameter.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "90 Degree Tees and Laterals," and "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards" for static class.

2.03 INTERNALLY INSULATED DOUBLE WALL DUCT AND FITTINGS

A. Construction to be comprised of airtight outer pressure shell, 1" insulation layer, and perforated metal inner line completely covering insulation.
B. Provide outer pressure shell manufactured from galvanized steel meeting ASTM A-525. Duct and fitting construction to be as specified for single wall round and flat oval duct.

C. Provide inner liner manufactured from galvanized steel meeting ASTM A-525 in the following minimum gauges:

<table>
<thead>
<tr>
<th>Diameter or Minor Axis, Inches</th>
<th>0&quot; - 34</th>
<th>35&quot; - 59</th>
<th>60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duct, Perforated Inner Liner</td>
<td>28</td>
<td>26</td>
<td>22</td>
</tr>
<tr>
<td>Fitting, Perforated Inner Liner</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
</tbody>
</table>

D. Perforations not to exceed 3/32" diameters. Percentage of open area to equal 13 percent.

E. Support inner liners of both duct and fittings with metal spacers welded in position to maintain spacing and concentricity.

F. Provide inner couplings to align inner lining to maintain airflow conditions equivalent to standard single wall medium-pressure duct joints. Butt joints are not acceptable for inner liner. Accomplish alignment by extending liner of fitting for slip joint into duct or by use of double, concentric coupling with two couplings held by spacers for rigidity and wall spacing. Provide insulation end fitting where internally insulated duct connects to uninsulated duct or fitting, fire damper, or flex to bring outer pressure shell down to nominal size.

G. Duct Access Doors
1. Provide double wall, insulated, factory fabricated access doors with dual latches and gaskets along perimeter. Door shall match leakage and pressure class ratings of duct where door is located.

2.04 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards" for acceptable materials, material thicknesses, and duct construction methods for static class. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.05 JOINT SEALER

A. Manufactured by Hardcast Inc., Two Stage-Sealant Process.
1. Apply fiber DT tape.
2. Brush on RT A-50 sealant over fiber tape.
2.06 GASKETS AND SEALS

A. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

B. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.07 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible,” Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:
   2. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations.
B. Install ducts according to SMACNA’s "HVAC Duct Construction Standards" for static pressure.

C. Seal all low pressure transverse and longitudinal joints with approved sealer in accordance with manufacturer's recommendation instructions.

D. Install round ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233713 "Air Duct Accessories" for fire and smoke dampers.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. All exposed ductwork shall be fabricated from paint grip sheet metal.

B. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

F. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards."

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233713 "Sheet Metal Specialties."
B. Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 START UP

A. Air Balance: Comply with requirements in Section 230593 “Testing, Adjusting, and Balancing for HVAC.”

3.07 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Intermediate Reinforcement:

C. Elbow Configuration:
   1. Rectangular Duct: Elbows shall be smooth radius with a centerline radius of 1.5 times the duct diameter.

D. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA’s "HVAC Duct Construction Standards," "Branch Connection for medium pressure ductwork."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Spun long radius bellmouth connections to be used at each round take off from medium pressure duct mains and plenums..
   2. Round: Comply with SMACNA’s "HVAC Duct Construction Standards," "90 Degree Tees and Laterals," and "Conical Tees." Saddle taps are permitted in existing duct.

E. Side Takeoff Fittings:
   1. Minimum 26 gauge: galvanized steel, designed for minimum pressure drop by an expansion from a rectangular connection to a round duct. The fitting shall include a 1” wide mounting flange with die formed corner clips, prepunched mounting holes, and an adhesive-coated flange gasket. The outlet collar shall be crimped and incorporate a bead.
   2. Manufacturer: Crown, of Flexmaster.

3.08 LEAK TESTING

A. Install medium pressure ductwork to be pressurized to 50% over design operating pressure of 6” wg. whichever is greater. Air leakage at test pressure to be measured by a calibrated orifice type flow meter. Total allowable leakage of system shall not exceed 1/2 of 1% of system air handling capacity.

END OF SECTION
SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1  GENERAL

1.01  QUALITY ASSURANCE

A.  Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B.  AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2  PRODUCTS

2.01  CENTRIFUGAL ROOF VENTILATORS

A.  Twin City, Cook or approved equal.

B.  Housing: Removable, All aluminum housing roof mounted, belt driven, down blast centrifugal exhaust fan; square, one-piece, aluminum base with venturi inlet cone.
1.  Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C.  Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D.  Belt Drives:
1.  Resiliently mounted to housing.
2.  Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
5.  Fan and motor isolated from exhaust airstream.

E.  Accessories:
1.  Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
2.  Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
3.  Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
4.  Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
   2. Overall Height: 12 inches.

2.02 IN-LINE MIXED FLOW CENTRIFUGAL FANS

A. Twin City, Cook or approved equal.

B. Housing: Housings constructed from heavy-gauge steel and shall be continuously welded.

C. Mixed flow impeller with airfoil die-formed continuously welded blades.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:
   1. Companion Flanges: For inlet and outlet duct connections.
   2. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
   3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
   4. Bolted access door

2.03 PROPELLER FANS

A. Twin City, Cook or approved equal.

B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

E. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

F. Fan Drive:
   1. Resiliently mounted to housing.
2. Statically and dynamically balanced.
3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
4. Extend grease fitting to accessible location outside of unit.
5. Service Factor Based on Fan Motor Size: 1.4.
6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
8. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.
9. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
10. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
11. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

G. Accessories:
1. Heavy duty gravity backdraft damper.
3. Wall Mounting Sleeve: Galvanized steel to match fan and accessory size.
4. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.04 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fans in accordance with manufacturer's published instructions.
B. Secure centrifugal roof mounted fans to curbs with stainless steel screws.
C. Connect ducts to fans to allow for straight and smooth airflow.

D. Provide flexible connections between fans and ducts.

E. Install fans level.

F. Check fan alignment and balance. Correct improperly aligned or vibrating fans.

G. Final installation to be free of leaks.

H. Ensure fans are interlocked with appropriate systems and/or controls.

END OF SECTION
PART 1  GENERAL

1.01  REQUIREMENTS

A. Variable volume air terminal units to be pressure independent, single duct, DD control type with hot water reheat coil as manufactured by Johnson Controls or Titus.

PART 2  PRODUCTS

2.01  VARIABLE VOLUME AIR TERMINAL UNITS

A. Provide pressure independent, single duct, DDC control type with hot water reheat coil as manufactured by Johnson Controls or Titus. Provide units complete with pressure taps and airflow curves for making air flow and pressure measurements. Terminal units to be pressure independent. Terminal unit airflow to be monitored by an integral, multiple point, averaging airflow sensing ring or cross to maintain constant airflow within 5 percent of rated cfm down to 25 percent of nominal cfm, independent of changes in system static pressure. Factory set, field adjustable settings for terminal unit maximum and minimum airflows to be provided in accordance with schedule on drawings. Integral flow taps and calibration chart to be provided for each terminal unit.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Provide terminal units with minimum 22-gauge welded steel housing. Casing shall be internally lined with 1/2” thick fiberglass insulation.
   1. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
   2. Air Outlet: S-slip and drive connections, size matching inlet size.
   3. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
   4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 6-inch wg inlet static pressure.

E. Hydronic Heating Coils: Provide factory mounted hot water reheat coils. Coils shall have a minimum .025 inch thick copper tube, with mechanically bonded aluminum fins. Design for minimum 200 psig and
220° F. Aluminum fins shall be a minimum of .0075 inch thick and spaced at a maximum of 12 fins/inch. Headers shall be heavy cast iron or steel. Designs shall be for a minimum operation of 200 psig at 220 degrees F. Coil casing shall be insulated with fiberglass duct wrap.

F. Maximum room N.C. due to discharge or radiated sound shall not exceed NC-35 when terminals are either in throttled or full open position with inlet static pressure ranging from 0.5 to 2" w.g. Correction of noise excesses not to constitute additional charges.

G. Controls:
   1. Terminal units to be complete with factory installed, direct digital control actuator for connection to DDC controls provided by control contractor.
   2. Coordinate controls with control contractor.

2.02 CASING LINER

A. Casing Liner: 1/2-inch thick elastomeric closed cell foam insulation. Insulation to be UL listed and meet NFPA-90A and UL-181 requirements.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to AHRI 880. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, and AHRI certification seal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide 3 diameters of straight duct at entrance to the terminal box. Final tie-in to the box shall be properly aligned so as not to restrict airflow into the box.

3.02 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5. "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.03 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain 36" clear on VAV terminal unit for piping and control access.

C. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

D. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves, and Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

E. Comply with requirements in Section 233113 "Sheet Metal Ductwork - Low Pressure" for connecting ducts to air terminal units.

F. Make connections to air terminal units with flexible connectors complying with requirements in Section 233713 "Sheet Metal Specialties."

G. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

END OF SECTION
SECTION 23 37 13
SHEET METAL SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Grilles, registers and diffusers shall be provided with frames, borders, and mounting attachments for installation in the actual wall, soffit and ceiling construction in which installed.

PART 2 PRODUCTS

2.01 AIR DISTRIBUTION TERMINALS

A. CD-1: Provide Square Ceiling diffusers equal to Titus Omni or approved equal with round duct collar, square center plaque face panel with 360 degree air pattern, all aluminum construction with sliding radial damper, where indicated on the drawings. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. Frame to match ceiling type. Finish shall be baked on, off-white enamel.

B. SD-1: Provide linear slot ceiling & side wall diffusers equal to Titus ML-39 or approved equal at all locations designated by schedule on drawings. Diffusers to be complete with horizontal to vertical airflow pattern adjustment. Minimum lengths of continuous border sections to be as indicated. Diffuser shall be furnished in multiple sections and joined together end-to-end with alignment pins to form a continuous slot appearance. Slot width to be one-inch. Total number of slots required to be indicated on drawings. Finish to be clear anodized aluminum. Provide flanged border and concealed mounting. Internal airflow pattern adjustment mechanism to be flat black. Provide each diffuser with insulated plenum with round duct connection, Titus MPI-39.


D. RG-1: Provide aluminum construction 24x24 return register complete with opposed blade damper and 1/2" x 1/2" x 1" cube egg-crate grid. Finish shall be off-white, baked on enamel. Reference architectural ceiling plans for lay-in or surface mount frame requirements.

E. SR-2: Sidewall Return Registers (Scene Shop): Provide Ruskin ELF15J fixer louver face, 45 degree, steel with white finish for paint adhesion.
2.02 FIRE DAMPERS
A. Fire dampers to be U.L. listed Dynamic in accordance with UL-555. Fire dampers to be held in an open position with a 165 degree F fusible link and arranged to lock in position on closure.

B. Fire dampers for rectangular duct to be type "B" and for round duct to be Type "C". Fire dampers for ductwork with a static pressure rating greater than 2" wg shall be Type "C". Fire dampers located behind sidewall registers and grilles and others specifically indicated on drawings to be Type "A". Fire dampers to be multi-leaf type with spring closing for horizontal mounting and weighted-gravity closing for vertical mounting. Dampers to be steel construction with rust resistant finish and provided with a factory-installed mounting sleeve suitable for structure. Mount per manufacturer's published U.L. approved installation instructions.

C. See Architectural drawings for hour-rating of walls and/or floors. Dampers to be compatible with hour ratings.

2.03 COMBINATION FIRE AND SMOKE DAMPERS
A. Low pressure ductwork: Ruskin Model FSD-36.


C. Install and mount qualified operator at time of fabrication by damper manufacturer. Furnish damper and operator by a single entity meeting applicable UL 555S qualifications for both damper and operator. Damper operator shall be of adequate size to open or close damper in 15 seconds.

2.04 SMOKE DAMPERS
A. Low pressure duct (2” pressure class and lower): Ruskin SD-35.

B. Medium pressure duct (4” - 6” pressure class): Ruskin SD-60.

C. Operators: Electric.

D. Install and mount qualified operator at time of fabrication by damper manufacturer. Operator shall be mounted out of airstream in accessible location. Furnish damper and operator by a single entity meeting applicable UL 555S qualifications for both damper and operator. Damper operator shall be adequate size to open or close damper in 15 seconds.

2.05 SLEEVES
A. Unless otherwise required by the authority having jurisdiction, sleeves for fire dampers and fire and smoke combination dampers shall be the rigid type of construction recommended in Schedule 2 of SMACNA Publication for "Fire Damper and Heat Stop Guide for Air Handling Systems". Use 16 gauge for ducts 24” or less in diameter or either rectangular dimension
and 14 for ducts over 24". Provide minimum 18" long sleeves. Coordinate required length with wall thicknesses.

B. Conform to the requirements of UL 555S. Test damper and operator as a unit to comply with UL 555S.

C. Install 1-1/2" x 1-1/2" x 1/8" angle bar on four sides of sleeves and both sides of wall.

D. Fasten angles to sleeve only.

E. Do not fasten angles to the wall.

2.06 AUTOMATIC CONTROL DAMPERS

A. All automatic control dampers to be furnished by Control subcontractor and installed by this Contractor (except unit mounted dampers).
   1. Automatic control dampers to be low-leak, galvanized steel or aluminum construction parallel blade type, Ruskin Model CD36, Arrow Series 395, or approved equal.
   2. Dampers to be complete with minimum 4" deep, 16-guage hat-shaped channel frame, minimum 16 gauge blades on maximum 6" centers, 1/2" diameter shafts, and corrosion resistant bearings.
   3. Dampers to have extruded vinyl blade seals and stainless steel or aluminum flexible metal compression type jamb seals to limit leakage to a maximum of ½% (maximum of 5.4 cfm/sq. ft. leakage for 48" x 48" size damper) when tested in accordance with AMCA Standard 500.
   4. Motor actuator to be oil immersed in gear train, 120-volt line voltage type with spring return to closed position on power interruption. Provide Honeywell Model M445/845, Barber-Colman MA-5210/5330 or approved equal complete with damper linkages.

2.07 MANUAL VOLUME DAMPERS

A. Type: Opposed blade.

B. Material: Steel, 3V type blades mounted in steel channel frame.

C. Shaft: 1/2" square rod operator with end bearings and gasket seal at duct penetrations. Terminate shaft in damper frame with bushings.

D. Operator: Locking quadrant handle with damper position indicator and insulation stand off mounting bracket for externally insulated ductwork.

2.08 FLEXIBLE CONNECTORS

A. Install UL listed flexible duct connectors between duct and fan/equipment connections. Flexible duct connectors to be made of 28-ounce, heavy glass fabric double coated with neoprene.

2.09 DUCT ACCESS DOORS
A. Duct access doors to be provided for access to all coils, fire dampers, automatic and backdraft dampers, duct smoke detectors, static pressure and air volume sensing devices, and other equipment installed in ducts and at other points indicated on drawings.

B. Access door construction and air tightness must be suitable for the duct pressure class used (low, medium, or high).

C. Access doors to be double-panel, galvanized steel construction with minimum 1" rigid insulation between panels. Access doors in exhaust duct may be uninsulated single panel, galvanized steel construction. Doors to mount in rigid frame constructed of formed galvanized steel. Angle iron bracing to be used as required to provide rigid assembly. Doors to hinge on one side with door latch on opposite side.

D. Access doors in ductwork shall fully comply with Figure 2-12 and 2-13 of SMACNA manual. Casing access doors shall fully comply with Figure 6-11 and 6-12 of SMACNA manual.

E. Doors to close against gasket seal.

F. Ductwork and/or equipment access doors shall be required at all motorized dampers, fire dampers, smoke detectors, airflow monitoring stations, duct-mounted temperature/pressure sensors and/or transmitters, vaned elbows, and any other mechanical and/or control device requiring inspection, maintenance or test access. In addition, 24" x 24" access doors shall be utilized wherever possible to facilitate adequate access for maintenance and/or testing.

2.10 FLEXIBLE DUCT (NON-CRITICAL NOISE AREAS ONLY)

A. Acceptable manufacturers:
   1. Flexmaster U.S.A., Model No. Type 5 insulated; Wiremold; Omniair 1200; J.P. Lanburn.

B. Characteristics of flexible duct to air terminals:
   1. Approved as UL Class 1 air duct.
   2. Flame spread less than 25, smoke developed rating less than 50.
   3. Insulated with 1/2" thick fiberglass insulation.
   4. Do not exceed four (4) feet flexible duct upstream of diffusers.
   5. Flexible duct shall meet standards of local building code.

C. Seal off the insulation jacket as its ends and at joints with mastic, hardcast, or similar material. Replace flex if jacket is punctured.

D. Install flexible duct without kinks or sags and support with 3/4" wide metal bands.

E. Do not route flexible duct through corridor walls, fire or smoke partitions.
F. No bends shall be made in flexible duct with the center line radius less than one and one-half duct diameter and only one bend may occur per four foot length of duct material.

2.11 BACKDRAFT DAMPERS

A. Backdraft Dampers (BDD): Backdraft dampers to be Ruskin Model CBD6 or approved equal low-leak counterbalanced backdraft dampers. Dampers to be heavy-duty type suitable for air velocities to 2500 fpm with all extruded aluminum construction, minimum 0.81" thick frame, and minimum .050" thick blades on maximum 4" centers. Provide blades with vinyl edge seals. Provide dampers with aluminum linkage and corrosion resistant type bearings. Provide dampers with adjustable counterbalances on blades to assist closing.

2.12 ROOF HOODS

A. Fabricate air inlet or relief hoods in accordance with SMACNA Low Pressure Duct Construction Standards.

B. Fabricate of 0.081 gauge extruded aluminum tiers welded to a minimum 8 gauge aluminum support structure. The aluminum hood shall be constructed of minimum 0.063 aluminum and provided with a layer of anti-condensate coating. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of 1/2" galvanized mesh shall be mounted across the relief opening.

C. Mount unit on minimum 14 inch high curb base with insulation between duct and curb.

D. Provide counterbalanced, adjustable barometric dampers in all relief hoods.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install sheet metal accessories in locations shown on drawings.

B. Install accessories in accordance with manufacturer’s published recommendations as well as applicable sections of SMACNA manual and other standards set forth in Part 1.

C. Provide all screw, bolts, nuts, inserts, and material required for attaching sheet metal to duct, walls, floors, and ceilings.

D. Install spin-in fitting with balancing damper in duct runout.

E. Provide minimum 24” x 24” access door in inaccessible ceilings and walls where needed for access to any inaccessible duct access doors or other mechanical equipment including valves, dampers, VAV boxes, etc.
3.02 TESTING

A. Check work for satisfactory installation and performance.

B. Insure that adequate access does in face exit for fire and smoke dampers and that damper operator motors are not hindered in operation by proximity to walls or other objects.

C. Check duct connections at access doors for air leakage or condensation. Correct conditions found.

END OF SECTION
SECTION 23 41 00
AIR FILTERS

PART 1   GENERAL (NOT APPLICABLE)

PART 2   PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:
   1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
   2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
   3. All filters to meet NFPA 90A requirements for flammability.

B. Comply with NFPA 90A and NFPA 90B.

2.02 MERV-8 DISPOSABLE FILTERS

A. Provide 30% medium efficiency, disposable, pleated media filters equal to Farr 30/30/ with a minimum rating of MERV-8 per ASHRAE 52.2 - 1999.

B. Each filter shall consist of a non-woven cotton media, media support grid, and enclosing frame.

C. Filter shall be listed by UL as Class II.

D. Average efficiency of MERV-8 on ASHRAE Test Standard 52.2-1999.

E. 2-Inch Thick Media: Effective filter media area shall not be less than 4.6 square feet of media per square foot of face area.

F. Provide one complete set of replacement filters to Owner at job completion.

2.03 FILTER GAGES

A. Manometer-Type equal to Dwyer inclined tube draft gage.

PART 3   EXECUTION

3.01 INSTALLATION

A. Install filter gage for each filter bank for each air handling unit.

B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
C. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

D. Coordinate filter installations with duct and air-handling-unit installations.

E. Contractor shall provide a new set of clean filters during construction bi-weekly if unit is operating.

F. Protect cooling coils and heating coils with filter media during construction.

G. Install temporary filters over grilles and openings on weekly basis during construction.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Listed double-wall vents.

PART 2 PRODUCTS

2.01 DOUBLE WALL POSITIVE PRESSURE SYSTEM

A. Provide UL tested and listed double wall pipe and fittings suitable for forced/induced draft boilers.

B. Suitable for use with natural gas.

C. Maximum 1000 degrees F continuous operating temperature, or 1400 degrees F intermittent.

D. Inner Shell:
   1. 20 gauge 304 stainless steel for natural gas.

E. Outer shell: 24 gauge aluminum coated steel.

F. Shell Separation: 1 inch air space.

G. Minimum rated clearance to combustibles: 10 inches.

H. Couplings: Flanged containment band.

I. AMPCO Model VSI-2, Metalbestos Model PS, or approved equal.

PART 3 EXECUTION

3.01 APPLICATION

A. Install double wall vent per manufacturer’s installation instructions.

3.02 INSTALLATION OF LISTED VENTS

A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer’s written installation instructions, using sealants recommended by manufacturer.
C. Support vents at intervals recommended by manufacturer to support weight of vent and all accessories.

D. Lap joints in direction of flow.

E. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION
SECTION 23.64.23

SCROLL WATER CHILLERS

PART 1      GENERAL

1.01 Packaged Air-Cooled Water Chillers

A. Acceptable Manufacturers: York YLAA and Carrier 30RB Scroll Type Chillers.

B. Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.

C. Cabinet:
   1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
   2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
   4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.
   5. Sound-reduction package consisting of the following:
      a. Acoustic enclosure around compressors.
      b. Reduced-speed fans with acoustic treatment.
      c. Designed to reduce sound level without affecting performance.
   6. Security Package: Provide security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.

D. Compressors:
   1. Description: Positive-displacement direct drive with hermetically sealed casing.
   2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
   3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
   5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.

E. Compressor Motors:
   1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

F. Compressor Motor Controllers:
1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

G. Refrigeration:
1. Refrigerant: R-410a. Classified as Safety Group A1 according to ASHRAE 34.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

H. Evaporator:
1. Brazed-plate or shell-and-tube design, as indicated.
2. Shell and Tube:
   a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
   b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
   c. Shell Material: Carbon steel.
   d. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
   e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
   f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
3. Brazed Plate:
   a. Direct-expansion, single-pass, brazed-plate design.
   b. Type 316 stainless-steel construction.
   c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
   d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.
4. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.
5. Remote Mounting: Designed for remote field mounting where indicated. Provide kit for field installation.
I. Air-Cooled Condenser:
   1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.
      a. Construct coils of copper tubes mechanically expanded to aluminum fins.
      b. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
   2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
   3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
   4. Fan Guards: Steel safety guards with corrosion-resistant coating.

J. Electrical Power:
   1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
   2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
   3. Wiring shall be numbered and color-coded to match wiring diagram.
   4. Install factory wiring outside of an enclosure in a raceway.
   5. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
   6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
      a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
      b. NEMA KS 1, heavy-duty, nonfusable switch.
      c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
   7. Provide each motor with overcurrent protection.
   8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
   10. Provide power factor correction capacitors to correct power factor to 0.95 at full load.
   11. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
      a. Power unit-mounted controls.
      b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.
   13. Indicate the following for water chiller electrical power supply:
      a. Current, phase to phase, for all three phases.
b. Voltage, phase to phase and phase to neutral for all three phases.
c. Three-phase real power (kilowatts).
d. Three-phase reactive power (kilovolt amperes reactive).
e. Power factor.
f. Running log of total power versus time (kilowatt hours).
g. Fault log, with time and date of each.

K. Controls:
1. Stand-alone, microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:
   a. Date and time.
   b. Operating or alarm status.
   c. Operating hours.
   d. Outside-air temperature if required for chilled-water reset.
   e. Temperature and pressure of operating set points.
   f. Entering and leaving temperatures of chilled water.
   g. Refrigerant pressures in evaporator and condenser.
   h. Saturation temperature in evaporator and condenser.
   i. No cooling load condition.
   j. Elapsed time meter (compressor run status).
   k. Pump status.
   l. Antirecycling timer status.
   m. Percent of maximum motor amperage.
   n. Current-limit set point.
   o. Number of compressor starts.
4. Control Functions:
   a. Manual or automatic startup and shutdown time schedule.
   b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on return-water temperature.
   c. Current limit and demand limit.
   d. External water chiller emergency stop.
   e. Antirecycling timer.
   f. Automatic lead-lag switching.
5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
   a. Low evaporator pressure or high condenser pressure.
   b. Low chilled-water temperature.
   c. Refrigerant high pressure.
   d. High or low oil pressure.
   e. High oil temperature.
   f. Loss of chilled-water flow.
   g. Control device failure.
6. BAS Communications: BAC net MS/TP

L. Insulation:
1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
2. Thickness: 1-1/2 inches.
3. Factory-applied insulation over cold surfaces of water chiller components.
   a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
4. Apply protective coating to exposed surfaces of insulation.

M. Accessories:
   1. Factory-furnished, chilled-water flow switches for field installation.
   2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.
   3. Factory-furnished neoprene or spring isolators for field installation.

N. Perform functional test of water chillers before shipping.
O. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
P. Rate sound power level according to ARI 370 procedure.

**PART 2  PRODUCTS**

2.01 WATER CHILLER INSTALLATION

A. Install water chillers on support structure indicated.
B. Equipment Mounting:
   1. Install water chillers on grade on a 6” thick concrete pad.
   2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Isolation for HVAC."
C. Maintain manufacturer's recommended clearances for service and maintenance.
D. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
E. Provide 5 year compressor warranty. Manufacturer shall warrant all equipment and material of its manufacture against defects in workmanship and material for a period of eighteen (18) months from date of shipment or twelve (12) months from date of start up, whichever occurs first.
F. Install separate devices furnished by manufacturer and not factory installed.
2.02 CONNECTIONS

A. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves, and Specialties. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Make connections to water chiller with a union, flange, or mechanical coupling.

D. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

2.03 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
   1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
   2. Verify that pumps are installed and functional.
   3. Verify that thermometers and gages are installed.
   4. Operate water chiller for run-in period.
   5. Check bearing lubrication and oil levels.
   7. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
  10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

END OF SECTION
SECTION 23 73 13

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1  GENERAL

1.01  DESCRIPTION

A. Provide Indoor single zone variable volume air handling unit and variable volume air handling units as scheduled.

1.02  PERFORMANCE REQUIREMENTS

A. Certify unit components in accordance with ARI Standard 430 as applicable.

B. Certify coils in accordance with ARI Standard 410.

PART 2  PRODUCTS

2.01  MANUFACTURERS

A. York/JCI, Carrier, and Trane.

2.02  UNIT CASINGS

A. Unit shall be double wall constructed in all sections.
   1. Exterior wall shall be minimum 18 gauge galvanized steel. Interior wall shall be minimum 20 gauge solid galvanized steel except at fan section which shall be perforated.
   2. All portions of the interior of the unit exposed to the airstream shall be covered with steel. Foil facing airstream is not acceptable. Insulate all sections with 2" thick 1-1/2lb matt faced fiberglass between two sheets of solid galvanized steel.
   3. The unit shall be supplied with full height, galvanized, double wall, hinged, removable access doors. Provide vent lock style handle that can be opened from unit interior.
   4. Provide IAQ drain pan under coil module. The drain pan shall be also provided under the complete supply fan section. Drain pans shall be stainless steel, double wall construction. Slope and construct drain pans to prevent standing water. Locate drain connection at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

B. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.
2.03 FANS

A. Provide supply fan section with plenum fan designed and suitable for class of service indicated in the unit schedule. Fan shaft to be properly sized and protectively coated with lubricating oil. Fan shafts shall be solid and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. Fans shall be statically and dynamically tested as an assembly at the required RPM to meet design specifications. Fan wheel shall be properly secured to shaft to prevent slippage.

B. Provide internal factory mounted canvas duct connection at fan discharge connection to fan module.

C. Provide self-aligning, grease lubricated pillow-block ball bearings with lubrication fittings. Provide extended grease lines to drive side of unit casing, for all fan bearings, rigidly attached for easy service access. Units shall include access doors on both sides of the units. All bearings shall perform to L-50 200,000 hour average life.

D. Fan, motor and drive shall be factory mounted with manufacturer's standard vibration isolation devices having a minimum of 2 inches static deflection.

2.04 MOTORS AND DRIVES

A. Fan motors to be mounted and isolated on the same integral base as the fan.

B. Fan motors shall be heavy duty, premium efficiency open drip-proof. See Section 23 05 13. Furnish "VFD Duty" motor for units with variable speed drives.

C. Factory Mount Fan Drives: Make final alignment and belt adjustment after installation. Design drive for 1.5 service factor.

2.05 AIR FILTRATION SECTION

A. Reference Section 234100.

2.06 COILS

A. Hot Water Preheat Coil:
   1. Coil to be constructed of 5/8" outside diameter tubing (0.024 inch thick) with minimum .009" thick aluminum fins and cast iron or copper headers. Bond fins by mechanical expansion.
   2. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.
   3. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.
B. **Hot Water Heating Coil:**
1. Coil to be constructed of 5/8" outside diameter tubing (0.024 inch thick) with minimum .009" thick aluminum fins and cast iron or copper headers. Bond fins by mechanical expansion.
2. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.
3. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.

C. **Chilled Water Cooling Coil:**
1. Coil to be constructed of 5/8" outside diameter tubing (0.024 inch thick) with not more than 11 fins per inch with minimum .009" thick aluminum fins and cast iron or copper headers. Bond fins by mechanical expansion.
2. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.
3. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.

### 2.07 ACCESS SECTIONS

A. Access sections shall be supplied between unit sections as show on drawings. Access doors shall be provided on both sides of section.

### 2.08 ADDITIONAL SECTIONS

A. **Double Wall Filter Section**
1. Refer to Section 234110 "Air Filters".
2. Provide factory-built filter section complete with filters as specified herein. Minimum filter area to be as specified on unit schedule but not to exceed 500 fpm filter face velocity. Filter sections to have full sized, hinged, latched, double wall access doors on both sides of section for filter service.
3. Provide medium efficiency (MERV 8), 2" thick pleated disposable type panel filters equal to Farr 30/30.
4. Provide high efficiency (MERV 13) 12" thick pleated disposable type cartridge filters equal to Farr Riga-Flo 100.
5. Provide a factory mounted Dwyer inclined tube draft gage across each filter section and mark gage to indicate design clean and dirty loading conditions.
6. Provide one complete set of replacement filters to Owner at job completion.

B. Double wall mixing section to have low-leak type outside and return air dampers with parallel blades. Arrange dampers so outside and return air merge when entering mixing box. Damper rods to rotate in nylon bushings.

C. Provide large coil access section for placement at chilled water coil, hot water coil, filter mixing section, and fan. Access doors shall be located on
both sides of sections. Doors shall be full sized, hinged, latched, and double wall.

2.09 DAMPERS
A. Dampers shall have airfoil blades with extruded vinyl edge seals and flexible metal compressible jamb seals. Dampers shall have a maximum leakage rate of 4 cfm/square foot at 1" w.c.

PART 3 EXECUTION

3.01 INSTALLATION
A. Rigidly install Air Handling Unit modules and base rails on a concrete curb sufficient height to install properly sized condensate drain.
B. Connect condensate drain pans using 1-1/2, ASTM B 88, Type M (ASTM B 88M, Type C) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
C. Arrange installation of units to provide access space around air-handling units for service and maintenance.
D. Install duct connections to each unit to allow for straight and smooth air flow. Do not install turns at the fan discharge which are in the opposite direction to the fan wheel and rotation.
E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
F. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
G. Install piping adjacent to air-handling unit to allow service and maintenance.
H. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
I. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves, and Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
J. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233713 "Sheet Metal Specialties."

END OF SECTION
SECTION 23 74 13

MODULAR, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1  GENERAL

1.01  PERFORMANCE

A. Certify unit components in accordance with ARI Standard 430 as applicable.

B. Certify coils in accordance with ARI Standard 410.

PART 2  PRODUCTS

2.01  MANUFACTURERS

A. JCI, Trane, Daiken.

2.02  CASING CONSTRUCTION

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.

3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. Access to filters, dampers, cooling coils, exhaust fans, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.

7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.

9. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.

10. Unit shall include lifting lugs on the top of the unit.

2.03 FANS

A. Provide supply fan section with plenum fan designed and suitable for class of service indicated in the unit schedule. Fan shaft to be properly sized and protectively coated with lubricating oil. Fan shafts shall be solid and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. Fans shall be statically and dynamically tested as an assembly at the required RPM to meet design specifications. Fan wheel shall be properly secured to shaft to prevent slippage.

B. Provide internal factory mounted canvas duct connection at fan discharge connection to fan module.

C. Provide self-aligning, grease lubricated pillow-block ball bearings with lubrication fittings. Provide extended grease lines to drive side of unit casing, for all fan bearings, rigidly attached for easy service access. Units shall include access doors on both sides of the units. All bearings shall perform to L-50 200,000 hour average life.

D. Fan, motor and drive shall be factory mounted with manufacturer’s standard vibration isolation devices having a minimum of 2 inches static deflection.

2.04 COOLING COILS

A. Chilled Water Cooling Coil:

1. Coils to be constructed of 5/8” outside diameter tubing (0.024 inch thick) with not more than 11 fins per inch with minimum .009” thick aluminum fins and cast iron or copper headers. Bond fins by mechanical expansion.

2. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.
3. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.

2.05 HOT WATER PRE-HEAT AND RE-HEATING COILS:

A. Coil to be constructed of 5/8" outside diameter tubing (0.024 inch thick) with minimum .009" thick aluminum fins and cast iron or copper headers. Bond fins by mechanical expansion.

B. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.

C. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.

2.06 FILTERS

A. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 35% and a MERV rating of 8, upstream of the cooling coil.

B. Unit shall include a clogged filter switch.

2.07 OUTSIDE AIR/ECONOMIZER

A. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq. ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood, and barometric relief dampers.

2.08 ADDITIONAL SECTIONS

A. Double Wall Filter Section:
   1. Provide factory-built filter section complete with filters as specified herein. Minimum filter area to be as specified on unit schedule but not to exceed 500 fpm filter face velocity. Filter sections to have full sized, hinged, latched, double wall access doors on both sides of section for filter service.
   2. Provide medium efficiency (MERV 8), 2" thick pleated disposable type panel filters equal to Farr 30/30.
   3. Provide a factory mounted Dwyer inclined tube draft gage across each filter section and mark gage to indicate design clean and dirty loading conditions.
   4. Provide one complete set of replacement filters to Owner at job completion.
B. Double wall mixing section to have low-leak type outside and return air dampers with parallel blades. Arrange dampers so outside and return air merge when entering mixing box. Damper rods to rotate in nylon bushings.

C. Provide coil access section for placement at chilled water coil, hot water coil, filter mixing section, energy recovery wheel, and fan. Access doors shall be located on both sides of sections. Doors shall be full sized, hinged, latched, and double wall.

D. Provide unit manufactured, insulated piping vestibules for chilled water coil, pre-heat hot water coil and re-heat hot water coils.

2.09 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
   1. Damper Motor: Modulating with adjustable minimum position.
   2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.10 AHU CURBS

A. Curbs shall be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the unit and mounted on the curb immediately before mounting of the unit.

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 2 inches.
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
PART 3 EXECUTION

3.01 INSTALLATION

A. Equipment Mounting:
   1. Install outdoor air handling units on factory roof curb.

B. Curb: Install in accordance with manufacturer's instructions.

C. Unit Support: Install unit level on curb. Secure AHU's to equipment rails with anchor bolts.

D. Install condensate drain, minimum connection size, with trap and indirect connection to nearest area drain.

E. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Connect supply ducts to AHU's with flexible duct connectors specified in Section 233713 "Sheet Metal Specialties."
   2. Install return and supply isolation plenums.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:
   1. Reference Section 230593 "Testing, Adjusting, and Balancing for HVAC".

3.03 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.

d. Liner Adhesive: Comply with ASTM C 916, Type I.
B. After completing system installation and testing, adjusting, and balancing AHU's and air-distribution systems, clean filter housings and install new filters.

END OF SECTION
SECTION 23 82 19

FAN COIL UNITS

PART  GENERAL

1.01 SUMMARY
A. Section includes horizontal concealed fan coil units.

PART 2  PRODUCTS

2.01 SYSTEM DESCRIPTION
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.02 HORIZONTAL FAN COIL UNITS
A. Provide JCI, Trane, Daiken or approved equal.
B. Fabricated of heavy gauge panels insulated with antimicrobial elastomeric closed cell foam insulation.
C. All concealed units shall have a minimum 1-1/4 inch duct collar on the supply discharge. Provide return air plenum section with a 1-inch duct collar. Unit shall have a hinged bottom access panel.
D. All exposed units shall have a power coated finish. All exterior panels shall be finished on both sides with an anodic acrylic power paint of the standard factory color. Provide side and bottom access panels with quick open fasteners. Provide double deflection discharge grille and a bottom return grille.
E. Unit fan shall be dynamically balanced, forward curved, DWDI centrifugal type constructed of galvanized steel. Motors shall be high efficiency, permanently lubricated sleeve bearing, permanent split-capacitor type with UL listed automatic reset thermal overload protection.
F. Provide primary drain pan constructed of heavy gauge type 304 stainless steel. Stainless steel drain pans shall be externally insulated. Provide a condensate overflow switch in the primary drain pan.
G. Chilled and hot water coils shall have minimum 1/2-inch copper tubes, collared and corrugated aluminum fins. Minimum working pressure of 200 psig. Include manual air vent and drain valve.
H. Provide 1-inch pleated throwaway filter.
I. Provide piping package including 2-way modulating control valve, isolation ball valves, unions and pressure-temperature ports.
J. Thermostat shall be unit mounted with integral three speed fan switch.
K. Provide horizontal units with hanger suspension.
L. Units to have internal electrical junction box suitable for single point permanent wiring connection. Provide disconnect switch at junction box.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. Install fan coil units level and plumb.
B. Install fan coil units to comply with NFPA 90A.
C. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 “Vibration and Isolation for HVAC.”
D. Verify locations of thermostats and sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.
E. Install new filters in each fan coil unit within two weeks after Substantial Completion.
F. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
   1. Install piping adjacent to machine to allow service and maintenance.
   2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
   3. Install condensate trap of adequate depth to seal against fan pressure.

3.02 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
B. Remove and replace malfunctioning units and retest as specified above.
C. Prepare test and inspection reports.
3.03 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION
SECTION 26 05 00
ELECTRICAL GENERAL PROVISIONS

PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide all materials, labor, and equipment required to furnish and install a complete electrical system as indicated on the Drawings and as specified herein.

B. Electrical work includes, but is not limited to, the following:

1. Complete distribution system for lighting and power including the necessary feeders, panelboards, branch circuits, conduit, lighting fixtures, control switches, and receptacles.

2. Excavation, trenching, and backfilling for conduit and/or cable.

3. Grounding

4. Data and Telephone system raceways, boxes, and cabling.

5. Power wiring for equipment furnished under Division 21, 22 and 23.

6. Fire Alarm System

1.02  RELATED WORK

A. The following work shall be furnished under other Divisions of these Specifications, but shall be coordinated with said Divisions by Division 26 tradesman prior to bid.

1. Flashing of conduits into roofing and outside walls.

2. Painting.

3. Cutting and patching.

4. Heating, ventilating, air conditioning, and plumbing equipment.

1.03  DEFINITIONS

A. Provide: Shall mean "furnish, install, connect, and put in good working order."

B. Wiring: Shall mean "wire and cable, installed in raceway with all required boxes, fittings, connectors, etc. completely installed."

C. Engineer: Shall mean "Engineer of Record" whose seal is affixed to the contract specifications and drawings of Division 26.

1.04  CODES AND STANDARDS

A. Comply with applicable local, state, and federal codes.

B. Electrical work shall be installed in accordance with the Drawings and Specifications, the 2011 NEC, 2012 IBC and applicable accessibility code.

C. In event of conflict between Drawings, Specifications and such codes, Engineer shall be notified in writing prior to bid. A ruling will then be made by the Engineer in writing. All work shall be installed in strict accordance with applicable codes without additional cost to Owner.
D. Contractor shall submit and/or file all necessary specifications and drawings as required by governing authorities.

1.05 SUBMITTALS

A. Provide submittals on materials and equipment identified in the Specifications and Drawings prior to manufacturer, order, or installation in accordance with Shop Drawings, Product Data, and Samples.

B. Submittals shall include but not be limited to the following:
   - Lighting fixtures
   - Switchgear
   - Fire Alarm System
   - Voice/Data cabling
   - Cable Tray

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.01 SITE VISIT

A. Visit job site prior to bid date to determine actual conditions under which work shall be done, to become familiar with project, and to verify total scope of work required. Failure to do so shall not constitute a reason for an extra charge.

3.02 COMMISSIONING

A. Complete testing of all lighting, wiring, generators, etc. per TBR specifications and complete the associated standard TBR/owner checklists.

END OF SECTION
SECTION 26.05.01

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1  GENERAL

1.01 QUALITY ASSURANCE

A. Qualifications of Manufacturer: All materials and equipment used in work of Division 26 shall be produced by manufacturers regularly engaged in manufacturer of similar items and with history of successful production acceptable to the Engineer. They shall be new and be UL listed and labeled or listed and labeled by other recognized testing laboratory where such label is available.

B. Qualifications of Installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of work of this Section.

1.02 GUARANTEE-WARRANTY

A. Guarantee work to be free of material and workmanship defects for a period of one year, from date of final acceptance for the project. Repair and replace defective work and other work damaged thereby which becomes defective during term of Guarantee-Warranty. Furnish Owner with three written copies of Guarantee-Warranty.

PART 2  PRODUCTS

2.01 SUBSTITUTIONS

A. Reference in Specifications to any article, device, product, material, fixture, form, and type of construction, by name, make, or catalog number shall be interpreted as established standard of quality and shall not be construed as limiting competition. Any article, device, product, material, fixture, form and type of construction which in the judgment of Engineer, expressed in writing, is equal to that specified, may be used.

B. Substitution shall be approved by Engineer before purchase and/or installation. If unapproved materials are installed, work required to remove and replace unapproved items shall be done at the Contractor's expense.

PART 3  EXECUTION

3.01 INSTALLATION

A. Electrical drawings are diagrammatic and shall not be scaled for exact sizes or locations. They are not intended to disclose absolute or unconditional knowledge of actual field conditions.

B. Equipment shall be installed according to manufacturer's recommendations.
C. Protect work and materials from damage by weather, entrance of water, and dirt. Cap conduit during installation. Avoid damage to materials and equipment in place.

D. Satisfactorily repair or remove and replace damaged work with new materials.

E. Trenching and backfilling shall comply with Site Work of these Specifications and provide sheathing, shoring, dewatering and cleaning necessary to keep trenches and their grades in proper condition for work to be carried on. Trenches shall be excavated 6” below elevation of bottom of conduit. Backfill shall be per Site Grading and Filling.

F. Failure to route conduit through building without interfering with other equipment and construction shall not constitute a reason for an extra charge. Equipment, conduit and fixtures shall fit into available space in building and shall not be introduced into building at such times and manner as to cause damage to structure. Equipment requiring services shall be readily accessible.

G. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
   1. Coordinate electrical systems, equipment, and materials installation with other building components.
   2. Verify all dimensions by field measurements.
   3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
   4. Coordinate the installation of required supporting devices and sleeves to be set in poured in-place concrete and other structural components, as they are constructed.
   5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
   6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
   7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
   8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
   9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, whether exposed or concealed.
   10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install access panels or doors where units are concealed behind finished surfaces.

12. Insulate dissimilar metals so they are not installed in direct contact.

H. Conduits which pass through floor slabs (except ground floor) shall be sealed with Fire Stop Sealant. Seal around conduits or other wiring materials passing through partitions, floors, and fire rated walls. Use UL approved Fire Stop Sealant as detailed on the drawings.

I. Coordinate electrical power connection requirements with all equipment suppliers. Where power requirements differ from drawing design requirements, Engineer shall be notified for clarification and installation requirements prior to installing that portion of work. Cost for equipment and labor for improperly installed electrical connections not coordinated and approved by other trades and the Engineer shall be incurred by the Electrical Contractor and shall not constitute a reason for an extra charge because of rework.

3.02 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

3.03 TESTING AND EQUIPMENT SERVICING

A. Entire installation shall be free from improper grounds and short or open circuits. Conductors shall be tested before energizing circuit. Test to insure that entire system is in proper operating condition, and that adjustments and settings of circuit breakers, fuses, control equipment, and apparatus have been made. Correct defects discovered during tests.

3.04 REMOVAL OF DEBRIS

A. Remove surplus materials and debris caused by, or incidental to electrical work. Remove such debris at frequent intervals. Keep job site clean during construction.

3.05 IDENTIFICATION OF EQUIPMENT

A. Equipment shall be identified in accordance with Section 26.05.53, “Electrical Identification.”

3.06 AS-BUILT DRAWINGS

A. Maintain one set of blue line electrical prints on site, marked to show as-built conditions and installations, prints to be turned over to Owner after job is complete.

3.07 TEMPORARY LIGHTING AND POWER

A. Provide, maintain and remove after construction is completed, temporary lighting adequate for workman safety and temporary power for all trades including any 1 phase power required.
3.8 POWER OUTAGES

A. Coordinate all power outages with Owner and submit for approval proposed schedule of work indicating extent, number, and length of outages required to perform work. Contractor shall include in bid cost of overtime labor required for power outage to occur after Owner's normal hours of operation.

3.09 OTHER MATERIALS

A. Work of this Division shall also include those items not specifically mentioned or described, but which are obviously necessary to conform to the design intent, applicable codes and to produce complete electrical system that functions properly. These materials shall be as selected by Contractor but subject to approval of the Engineer.

3.10 OTHER COORDINATION

A. Contractor shall obtain and pay for all necessary permits and inspection fees required for the electrical installation.

B. Contractor shall coordinate electrical service requirements with the local electric utility company, and provide any required fee, conduit, transformer pad, metering equipment, etc. that is required.

END OF SECTION
SECTION 26 05 16

CONDUIT

PART 1  GENERAL

1.01 WORK INCLUDED

A. Provide a complete conduit system to support all electrical equipment and systems. Conduit system includes conduit, couplers, connectors, fittings, boxes, covers and supports.

B. No conduit serving branch circuits shall be installed in or below concrete slabs unless required for branch circuits serving loads located in the center of a room.

1.02 QUALITY ASSURANCE

A. Listing and Labeling: Provide conduit that is listed and labeled.

1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Conduit and its installation shall comply with requirements of the National Electrical Code.

PART 2  PRODUCTS

2.01 CONDUIT

A. Electric Metallic Tubing (EMT): Allied, Wheatland, LTV Copperweld, or approved equal.

B. Rigid Metal Conduit (RMC): Allied, Wheatland, Republic, or approved equal.

C. Flexible Steel Conduit (Greenfield): Alflex, Electroflex, Greenfield, or approved equal.

D. Rigid Non-Metallic Conduit (PVC): Carlon Schedule 40, Cantex, Southern Pipe, Schedule 80 or approved equal.

E. Liquid-tight Flexible Metallic Conduit (LFMC): Aflex, Electroflex, Seal-tite, or approved equal.

2.02 CONDUIT FITTINGS


B. Bushings: Appleton, T&B, O.Z., or Gedney

C. Straps and Hangers: Appleton, T&B, Steel City, or Minerallac.
D. Group Pipe supports: Unistrut, Kindorf, B-Line, or approved equal.

E. Expansion Fittings: O.Z. Gedney Type AX, or equal by Appleton, or approved equal.


**PART 3  EXECUTION**

3.01 CONDUIT

A. In general, conduit installation shall follow layout shown on drawings. However, this layout is diagrammatic only and where changes are necessary due to structural conditions, other apparatus or other causes, such changes shall be made without cost to Owner. Offsets in conduits are not indicated and must be furnished as required.

B. Conduit shall be installed in accordance with the National Electrical Code.

C. Provide bushings on the open ends of conduit containing conductors. Insulated bushings shall be provided for conduits containing conductors #4 AWG or larger with an insulating ring an integral part of the bushing.

D. Use EMT where Drawings call for conduit to be concealed in walls or above ceilings or when cast in concrete slabs not on grade. Do not use EMT exposed lower than 4’ above floor, in wet locations, or in exterior applications.

E. Use Schedule 40 PVC encased in concrete or when installed underground. Use Schedule 80 PVC when exposed.

F. When PVC conduit is used, turn up perpendicular to slab.

G. Support conduit and secure to forms when cast in concrete so that conduit will not be displaced during pouring of concrete. Stuff boxes and cork fittings to prevent entrance of water during concrete pouring and at other times during construction, prior to completion of conduit installation.

H. Route all conduit at right angles or parallel to walls of building.

I. Use proper sized tools for bending. Do not heat metal conduit. Dents and flat spots will be rejected. Cut and thread conduit so ends will butt in couplings. Make threads no longer than necessary and ream pipe free of burrs.

J. Minimum conduit size 1/2” unless otherwise required.

K. Leave one #10 AWG or equivalent nylon pull wire in empty conduits.

L. Use short pieces, approximately five (5’) feet of flexible conduit to connect motors and other devices subject to motion and vibration. Use liquid tight flexible conduit where outside or subject to water spray.
3.02 CONDUIT FITTINGS

A. When EMT is installed concealed in walls or above ceilings use steel double set screw connectors. All connectors shall have throated insulating bushing.

B. Support conduit vertically and horizontally by straps or hangers. Do not exceed intervals as described in the National Electrical Code.

C. Use expansion fittings, properly bonded to assure ground continuity, across expansion joints in floors and ceilings. Use double lock nuts and bushings on panel feeders at panel cans.

D. When connections are made to motors or other equipment, not near walls or columns, provide a vertical conduit, minimum 3/4", attached to floor with a floor flange, bring wiring out of this conduit by means of a condulet and flexible conduit extending to equipment junction box.

END OF SECTION
SECTION 26 05 19
WIRE AND CABLE

PART 1  GENERAL

1.01  WORK INCLUDED

A. Wire and cable for all service, feeders, branch circuits, and instrument and control wiring rated 600 volts and below.

1.02  QUALITY ASSURANCE

A. Listing and Labeling: Provide wire and cable that is listed and labeled.
   1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Wire and cable and its installation shall comply with requirements of the National Electrical Code.

PART 2  PRODUCTS

2.01  MATERIALS

A. Wires and cables shall meet applicable requirements of the National Electrical Code and UL for the type of insulation, jacket, and conductor specified or indicated.

B. All conductors shall be copper with 600 volt insulation unless otherwise indicated.

C. Wire and cable shall be manufactured by Belden, General Cable, Essex, Encore, Rome Cable, Southwire, or approved equal.

D. Use solid copper type THHN/THWN for branch circuit wiring #10 AWG and smaller. No conductor for branch circuit wiring shall be smaller than #12 AWG.

E. Use stranded copper, type THHN/THWN for feeder and power circuits #8 AWG and larger.

F. Provide color coded wire and with a different color for each phase and neutral and ground as follows: 208/120 volt circuits - phases A, B, and C: black, red, and blue respectively; neutral: white; ground: green, 480/277 volt circuits – phases A, B, and C: brown, orange, and yellow, respectively, neutral: gray; ground: green. Approved color tape is acceptable for feeders. Also provide color coded wire for control circuits.
PART 3  EXECUTION

3.01  INSTALLATION

A.  Complete conduit system before pulling any wire or cable. Use cable lubricants recommended by cable manufacturer as necessary.

B.  Conductors shall be continuous from outlet to outlet or to branch circuit over-current devices. Make splices only in junction boxes. Splices shall not be made in panelboards. Control wiring shall be continuous between components and/or terminal boards.

C.  A minimum of eight (8") inches of slack conductor shall be left in every outlet or junction box. There should also be enough slack so three (3") inches extends outside the outlet or junction box.

D.  Make splices in conductors #10 AWG and smaller diameter with insulated, pressure-type connector. Use Scotchlok, Ideal, or equal wire connectors.

E.  Make splices in conductors #8 AWG and larger diameter with solderless connectors and cover with insulation material equivalent to conductor insulation. Use Burndy compression connectors with “crimp-it” cover, type CC, or equal.

3.02  TESTING

A.  After completion of the installation and splicing and prior to energizing the conductors, wire and cable shall be given continuity and insulation tests as herein specified.

B.  Test wiring to verify that no short circuits, open circuits, or accidental grounds exist. Continuity tests shall be conducted using a dc device with bell or buzzer.

C.  Perform Megger tests on wiring #4 AWG and larger.

END OF SECTION
PART 1  GENERAL

1.01  WORK INCLUDED

A.  Grounding electrodes and conductors.
B.  Equipment grounding conductors.
C.  Bonding.

1.02  PERFORMANCE REQUIREMENTS

A.  The grounding system to earth resistance shall be less than 5 ohms.

1.03  QUALITY ASSURANCE

A.  Listing and Labeling:  Provide grounding and bonding materials that are listed and labeled.
   1.  The term "listed and labeled":  As defined in the National Electrical Code, Article 100.
   2.  Listing and Labeling Agency Qualifications:  A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B.  Components and installation shall comply with the requirements of the National Electrical Code (NEC).

C.  Materials shall comply with UL 467, "Grounding and Bonding Equipment."

PART 2  PRODUCTS

2.01  MANUFACTURERS

A.  Manufacturers shall be Burndy, T&B, or approved equal.

2.02  GROUNDING ELECTRODES

A.  Ground rods shall be copper clad steel with minimum dimensions of ¾ inch diameter by 10 feet long.

2.03  CONNECTORS

A.  Exothermic welded connections shall be provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

B.  Pressure connectors shall be high-conductivity-plated units.
C. Bolted clamps shall be heavy-duty units listed for the application.

2.04 WIRE AND CABLE

A. All grounding conductors shall be copper.
B. The grounding electrode conductor shall be stranded.
C. Equipment grounding conductors shall have green insulation.
D. Bare copper conductors shall conform to the following:
   1. Solid conductors: ASTM B-3
   2. Assembly of stranded conductors: ASTM B-8
   3. Tinned Conductors: ASTM B-33

2.05 MISCELLANEOUS CONDUCTORS

A. Ground bus shall be bare annealed copper bars.
B. Braided bonding jumpers shall be copper tape, braided number 30 gauge bare copper wire, and terminated with copper ferrules.
C. Bonding strap conductor/connector shall be soft copper, 0.05 inch thick and two (2") inches wide, unless otherwise noted.

PART 3 EXECUTION

3.01 INSTALLATION

A. Grounding system shall be in accordance with Article 250 of the NEC except where the Drawings or Specifications exceed NEC requirements.
B. Install code size green grounding conductors in all feeder and branch circuits. Bond conductors to chassis or fixed equipment.
C. All grounding conductors shall be bonded to multi-terminal ground bus at panelboard or other distribution equipment. Grouping of grounding conductors under a single lug is not acceptable.
D. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.
E. Bond structural steel and reinforcing steel in foundation footing to grounding electrode conductor. Bond steel together. Every corner column and every other column in between shall be connected to the ground ring.
F. Locate all grounding attachments away from areas subject to physical damage. Provide protective covering as required.
G. All separate grounding electrodes shall be bonded together to limit potential differences between them and between their associated wiring systems. This includes the power system, TVSS, telephone system, and system grounding electrodes.

3.02 CONNECTIONS

A. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
   2. Make connections with clean bare metal at points of contact.
   3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
   4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

B. Use exothermic welded connections for connections to structural steel and for underground connections. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. For compression-type connections, use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

D. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

E. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

F. Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.
G. Do not use flexible metal conduit and fittings as a grounding means. Pull a green wire in each piece of flexible conduit, and screw to conduit system with lugs at both ends.

3.03 FIELD QUALITY CONTROL

A. Use the fall-of-potential method as described in IEEE Standard 81 to measure the resistance of the following. Record the measurements and provide to the Engineer.
   1. The resistance between earth and each ground rod prior to interconnection with other ground rods.
   2. The resistance between earth and the counterpoise.
   3. The resistance of the grounding system at the grounding electrode connection to earth.
      a. Measure the ground resistance when there has been no precipitation for 5 days, without the soil being moistened by any means other than natural precipitation or natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance.
   4. Resistance shall be less than 15 ohms.

B. Perform continuity tests at all power receptacles to ensure the ground terminals are properly grounded to the facility ground network.

END OF SECTION
SECTION 26 05 29
SUPPORTING DEVICES

PART 1  GENERAL

1.01  WORK INCLUDED

A.  This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fasteners.

1.02  QUALITY ASSURANCE

A.  Electrical Component Standard: Components and installation shall comply with the National Electrical Code.

PART 2  PRODUCTS

2.01  MANUFACTURERS

A.  Subject to compliance with requirements, Slotted Metal Angle and U-Channel Systems shall be provided by Allied Tube & Conduit, American Electric, B-Line Systems, Inc., Unistrut Diversified Products, or approved equal.

B.  Subject to compliance with requirements, Conduit Sealing Bushings shall be provided by Bridgeport Fittings, Inc., Cooper Industries, Inc., Killark Electric Mfg. Co., O-Z/Gedney, Raco, Inc., Spring City Electrical Mgf. Co., Thomas & Betts Corp., or approved equal.

2.02  COATINGS

A.  Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be aluminum or hot-dip galvanized.

2.03  MANUFACTURED SUPPORTING DEVICES

A.  Raceway Supports: Raceways shall be supported with clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B.  Fasteners: Types, materials, and construction features as follows:
   1.  Expansion Anchors: Carbon steel wedge or sleeve type.
   2.  Toggle Bolts: All steel springhead type.

C.  Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body,
neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

E. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

2.04 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of one of the following:
   1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
      a. 3-inch and smaller: 20-gauge.
      b. 4-inch to 6-inch: 16-gauge.
      c. over 6-inch: 14-gauge.
   2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Raceway Supports: Comply with the NEC and the following requirements:
   1. Conform to manufacturer's recommendations for selection and installation of supports.
   2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers.

5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

6. Space supports for raceway types not covered by the above in accordance with NEC.

7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors.

E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

G. Sleeves: Install in concrete slabs and walls and all other fire rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with manufacturer’s recommendations.

H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited
to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.

END OF SECTION
SECTION 26 05 33
OUTLET AND JUNCTION BOXES

PART 1  GENERAL

1.01 WORK INCLUDED

A. Wall and ceiling outlet boxes.

B. Pull and junction boxes.

1.2 QUALITY ASSURANCE

A. Listing and Labeling: Provide outlet and junction boxes that are listed and labeled.
   1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Outlet and junction boxes and their installation shall comply with the requirements of the National Electrical Code.

PART 2  PRODUCTS

2.1 OUTLET AND JUNCTION BOXES

A. Outlet and junction boxes shall be galvanized steel, 1-1/2" deep minimum by Raco, T&B/Steel City, Crouse Hinds or approved equal.

B. Boxes for interior areas with exposed conduit shall be pressed steel and in exterior areas with exposed conduit shall be cast metal with threaded hubs, "FS" type. Use galvanized steel for concealed boxes.

PART 3  EXECUTION

3.1 GENERAL

A. Outlet and junction boxes in inaccessible ceiling areas shall be located no more than 6 inches from ceiling access panel or from removable recessed luminaire.

B. Install boxes to preserve fire resistance rating of partitions and other elements, using UL listed fire stop materials and methods.

C. Do not install flush mounted boxes back-to-back in walls; provide minimum six (6") inches separation. Provide minimum twenty-four (24") inches separation in fire rated walls.
D. Do not fasten boxes to ceiling support wires.

E. Support boxes independently of conduit.

F. Bonding jumpers shall be used around knockouts.

3.2 OUTLET BOXES

A. Outlet boxes shall be securely anchored, set true, and plumb and no part of box shall extend beyond finished wall or ceiling. Flush mounted boxes shall be set to within 1/8" of finished wall and a plaster ring used to make cover flush with wall.

B. Select boxes according to intended use and type of outlet. Ceiling outlet boxes shall be four (4") inches octagon and 2-1/2" deep minimum. Use four (4") inches square boxes where required. All ceiling outlet boxes shall have a fixture stud of the no bolt, self-locking type if required to hang the fixture specified at the outlet.

C. Receptacle and switch boxes installed in concrete block walls not plastered shall be Steel City, Appleton, Raco Series No. 690 through No. 699, or approved equal masonry boxes of proper depth and gang required and specifically designed for this purpose. If more than two conduits enter box from one direction, 4" square boxes with square-cut device covers not less than one (1") inch deep specifically designed for this purpose, shall be used. Round edge plaster rings will not be acceptable for block walls. Sectional or gangable type outlet boxes will not be acceptable except in drywall construction.

D. Mount outlet boxes worked to nearest block course. Confirm ADA compliance.

E. Install blank device plates on outlet boxes left for future use.

F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Confirm accessibility code compliance.

3.3 JUNCTION BOXES

A. Pull and junction boxes shall be sized in accordance with the National Electrical Code according to number of conductors in box or type of service to be provided. Minimum size is 4-11/16" square and 2-1/2" deep.

B. Pull boxes shall be provided where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with bends exceeding 270 degrees shall have a pull box installed at a convenient intermediate location.

C. Install in locations as shown on Drawings and as required for splices, taps,
wire pulling, equipment connections, and compliance with regulatory requirements.

D. Install pull and junction boxes above accessible ceilings and in unfinished areas only.

3.4 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

3.5 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION
SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Extent and types of electrical identification are indicated herein and as follows:
   1. Operational instructions and warnings.
   2. Danger signs.
   3. Equipment/system identification signs.
   5. Power and control wiring identification.
   6. Terminal marking.
   7. Arc-flash warning.
   8. Panelboard Legends.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, identification products shall be provided by W.H. Brady Co., Ideal Industries, Inc., Panduit, T&B, or approved equal.

2.02 MATERIALS

A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Cable/Conductor Identification Bands: Provide manufacturer's standard wrap-around type, vinyl-cloth, self-adhesive cable/conductor markers with either pre-numbered plastic coated type or write-on type with clear plastic self-adhesive cover flap, numbered to show circuit identification. Provide markers for all field control wiring.

C. Self-Adhesive Plastic Signs: Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings. Signs shall be of sizes suitable for application areas and adequate for visibility, with proper wording for each application (as examples: 208V, EXHAUST FAN or DANGER – HIGH VOLTAGE).
   1. Colors: Unless otherwise indicated or required by governing regulations, provide orange signs with black lettering.

D. Engraved Plastic-Laminate Signs: Provide three-layer engraving stock in sizes and thickness indicated, engraved with engraver's standard letter style of sizes and wording indicated, black and white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
1. Thickness: 1/16", for units up to 20 sq. in. or eight (8") length; 1/8" for larger units.

2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

E. Underground Warning Tape: Provide four (4") inch wide detectable type, plastic, yellow warning tape with suitable warning describing type of cable/circuit over buried electrical lines.

2.03 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations, and other designations used in electrical identification work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering, and working as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment.

PART 3 EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Coordination: Where identification is to be applied to surfaces, which require finish, install identification after completion of painting.

2. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

3. Conduit Identification: Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by a color-coded method, apply color-coded identification on electrical conduit in a manner similar to piping identification. Except as otherwise indicated use orange as coded color for conduit.

4. Equipment/System Identifications: Install engraved plastic-laminate sign on each disconnect and control cabinets. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide identification and warning signs for each unit of the following categories of electrical work.
   a. Electrical cabinets and enclosures.
   b. Panelboards
   c. Access panel/doors to electrical cabinets.
   d. Control stations.
   e. Disconnect switches.

B. Install signs at locations indicated or, where not otherwise indicated, at locations for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with stainless steel tamperproof fasteners.

C. Install danger signs on all disconnect and control cabinet exteriors.
D. Install danger and notice to disconnect power before removing or opening on all inner panels.

E. Install underground warning tape in accordance with the National Electrical Code.

END OF SECTION
SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section includes circuit breakers and fuses.

1.02 SUBMITTALS

A. Provide manufacturer’s product data for the following:
   1. Circuit breakers
   2. Enclosures
   3. Fuses (Provide complete list of all fuses and the equipment where they are used.)
   4. Shunt trips

B. Provide maintenance data for products for inclusion in the Operating and Maintenance Manual.
   1. Include a load current and overload relay heater list complied by Contractor after motors have been installed. Arrange list to demonstrate selection of heaters to suit actual motor nameplate full load currents.

1.03 QUALITY ASSURANCE

A. Listing and Labeling: Provide overcurrent protective devices that are listed and labeled.
   1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Overcurrent protective devices and their installation shall comply with the requirements of the National Electrical Code.

C. Circuit breakers shall comply with UL 489, NEMA AB 1, and NEMA AB 3.

D. Fuses shall conform to NEMA FU 1.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Circuit Breakers: Subject to compliance with requirements, provide products by Cutler-Hammer; General Electric Co.; Siemens Energy & Automation, Inc.; Square D Co.; or approved equal.
B. Fuses: Subject to compliance with requirements, provide products by Bussmann Mfg. Co., Littlefuse Co, Ferraz Shawmut, or approved equal.

2.02 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be bolt-on only. Plug-in type circuit breakers are not permitted.

B. Circuit breakers shall be molded case, manually operated, trip-free, with inverse-time, thermal-overload protection, and instantaneous magnetic, short-circuit protection, as required. Circuit breakers shall be completely enclosed in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

C. Thermal-magnetic tripping elements shall be located in each pole of the circuit breaker and shall provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. On frame sizes larger than 100 amperes, the instantaneous magnetic tripping element shall be adjustable and accessible from the front of the breaker.

D. Breaker size shall be as required for the continuous current rating of the circuit. Breaker class shall be as required.

E. Interrupting capacity of the branch circuit breakers shall be sufficient to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Circuit breaker minimum interrupting capacities shall be as shown on drawings and shall conform to NEMA AB 3.

F. Multipole circuit breakers shall be of the common-trip type having a single operating handle and shall have a two-position on/off indication. Circuit breakers shall have temperature compensation for operation in an ambient temperature of 104 degrees F. Circuit breakers shall have root mean square (rms) symmetrical interrupting rating sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

G. Breaker body shall be of phenolic composition. Breakers shall be capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

H. Provide UL listed service entrance equipment when used for service disconnect.
I. Circuit breakers used for switching high intensity discharge lights or fluorescent lights shall be rated for that type of service.

2.03 ENCLOSED MOLDED-CASE CIRCUIT BREAKERS

A. Enclosed circuit breakers shall be thermal-magnetic, molded-case circuit breakers in surface-mounted, non-ventilated enclosures, conforming to the appropriate articles of NEMA 250 and NEMA AB 1.

2.04 FUSES

A. A complete set of fuses for all switches shall be provided. Fuses shall have a voltage rating not less than the circuit voltage.

B. Provide Class RK5 fuses for motor branch circuits.

C. Fuses shall be labeled showing UL class, interrupting rating, and time-delay characteristics, when applicable.

D. Fuse holders field-mounted in a cabinet or box shall be porcelain. Field installation of fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber shall not be used.

E. Provide a minimum of three (3) spare fuses of each size and type fuse installed.

F. Provide a complete list of all fuses and the equipment where they are used.

2.05 EQUIPMENT ENCLOSURES

A. Enclosures for equipment shall be in accordance with NEMA 250.

B. Equipment installed inside, clean, dry locations shall be contained in NEMA Type 1, general-purpose sheet-steel enclosures.

C. Equipment installed in wet locations shall be contained in NEMA Type 3R, rainproof, sheet-steel enclosures, constructed for outdoor use to protect against falling rain, sleet, and ice.

D. Ferrous-metal surfaces of electrical enclosures shall be cleaned, phosphatized, and painted with the manufacturer’s standard finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install overcurrent protective devices as indicated or required, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with
B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices.

C. Fasten circuit breakers without mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cables.

D. Install enclosed circuit breakers plumb with operating handle at five (5') feet above finished elevation.

E. Set field-adjustable circuit breakers for trip settings as indicated, subsequent to installation of devices.

F. Provide engraved plastic-laminate identification under the provisions of Section 26.05.53, "Electrical Identification" for enclosed circuit breakers and motor controllers.

3.02 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

B. In the presence of the Owner or Owner’s Representative, test each device and demonstrate its working as specified.

END OF SECTION
SECTION 26 22 00

DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.02 REFERENCES

A. The transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, NEMA and UL.

B. Transformers shall meet the requirements of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment"

1.03 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:
   1. Outline dimensions and weights
   2. Technical certification sheet
   3. Transformer ratings including:
      a. kVA
      b. Primary and secondary voltage
      c. Taps
      d. Basic impulse level (BIL) for equipment over 600 volts
      e. Design impedance
      f. Insulation class and temperature rise
      g. Sound level.
   4. Product data sheets

1.04 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes.
   1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
   2. Connection diagrams
   3. Installation information
   4. Seismic certification and equipment anchorage details as specified

1.05 QUALIFICATIONS
A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.06 REGULATORY REQUIREMENTS

A. All transformers shall be UL listed and bear the UL label.

1.07 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton, Square-D, General-Electric, or Siemens products

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Other manufacturers will be considered, provided their products meet the requirements of the documents.

2.02 RATINGS

A. The kVA and voltage ratings shall be as indicated on the drawings.

B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.

C. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

<table>
<thead>
<tr>
<th>Range (kVA)</th>
<th>Sound Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9</td>
<td>40</td>
</tr>
<tr>
<td>10 to 50</td>
<td>45</td>
</tr>
<tr>
<td>51 to 150</td>
<td>50</td>
</tr>
</tbody>
</table>
2.03 CONSTRUCTION – GENERAL PURPOSE TRANSFORMERS

A. Insulation Systems
   1. Transformer insulation system shall be as follows:
      a. Less than 15 kVA: 185 degrees C insulation system with 115 degree C rise, encapsulated design; 15 kVA and above: 220 degree C insulation system with 115 degree C rise, ventilated design.
   2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C.
   3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

B. Core and Coil Assemblies
   1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction.
   2. On three-phase units rated 15 kVA and below the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.
   3. On three-phase units rated 15 kVA and above the core and coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The assembly shall be installed on vibration-absorbing pads.

C. Taps
   1. Three-phase transformers rated 15 through 500 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage.
   2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer’s standard tap configuration.

D. Electrostatic Shielding
   1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of a single turn.

<table>
<thead>
<tr>
<th>Capacity (kVA)</th>
<th>Noise Level (dB)</th>
</tr>
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<tbody>
<tr>
<td>151 to 300</td>
<td>55</td>
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<tr>
<td>301 to 500</td>
<td>60</td>
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<tr>
<td>501 to 700</td>
<td>62</td>
</tr>
<tr>
<td>701 to 1000</td>
<td>64</td>
</tr>
<tr>
<td>1001 to 1500</td>
<td>65</td>
</tr>
</tbody>
</table>
of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.

2.04 ENCLOSURE – GENERAL PURPOSE TRANSFORMERS

A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C. The core of the transformer shall be grounded to the enclosure.

B. On three-phase units rated 15 kVA and below the enclosure construction shall be encapsulated, totally enclosed, non-ventilated, NEMA 3R, with lifting eyes.

C. On three-phase units rated 15 kVA and above the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt.

2.05 FINISH

A. Enclosures shall be finished with ANSI 61 color, weather-resistant enamel.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
1. Ratio tests at the rated voltage connection and at all tap connections
2. Polarity and phase relation tests on the rated voltage connection
3. Applied potential tests
4. Induced potential test
5. No-load and excitation current at rated voltage on the rated voltage connection

3.02 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

3.03 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.

3.04 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION
SECTION 26 24 00

MECHANICAL EQUIPMENT AND CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. General provisions of contract, including general and supplementary conditions and general requirements apply to work specified in this section.

PART 2 PRODUCTS

2.1 STARTERS

A. All starters for Division 22 and 23 package mechanical equipment will be furnished by Division 22 and 23, but installed and connected by Division 26.

2.2 CONTROL WIRING

A. All control wiring for mechanical equipment shall be provided in conduit under each respective division. Control components for mechanical equipment will be furnished and installed by Division 22 and 23.

2.3 POWER WIRING

A. All power wiring at 120, 208, 277 and 480 volts shall be provided by Division 26.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate electrical power connection requirements with Mechanical Contractor. Where power requirements differ from drawing design requirements, Engineer shall be notified in writing. Contractor shall be given clarification and installation requirements prior to installation of the portion of work. Cost of equipment and labor for improperly installed electrical connections not coordinated and approved by Engineer and Mechanical Contractor shall be incurred by the Electrical Contractor and shall not constitute a reason for an extra charge because of any rework.

END OF SECTION
**SECTION 26 24 16**

**PANELBOARDS**

**PART 1  GENERAL**

1.01  SCOPE

A. The Contractor shall furnish and install the panelboards as specified and as shown on the contract drawings.

1.02  REFERENCES

A. The panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL as follows:
   1. UL 67 – Panelboards
   2. UL 50 – Cabinets and boxes
   3. NEMA PB1
   5. Circuit breaker – Type I class I
   6. Fusible switch – Type II class I

1.03  SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:
   1. Breaker layout drawing with dimensions indicated and nameplate designation
   2. Component list
   3. Conduit entry/exit locations
   4. Assembly ratings including:
      a. Short-circuit rating
      b. Voltage
      c. Continuous current
   5. Cable terminal sizes
   6. Product data sheets

B. Where applicable, the following additional information shall be submitted to the Engineer:
   1. Key interlock scheme drawing and sequence of operations

1.04  SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:
   1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
   2. Installation information

1.05  QUALIFICATIONS
A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The panelboards shall be UL labeled.

1.07 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton, Square-D, General Electric, and Siemens

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Other manufacturers will be considered, provided their products meet the requirements of the documents.

2.02 RATINGS

A. Panelboards rated 240 Vac or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.

B. Panelboards rated 480 Vac shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 14,000 amperes RMS symmetrical.

C. Panelboards shall be labeled with a UL short-circuit rating. When series ratings are applied with integral or remote upstream devices, a label or
manual shall be provided. It shall state the conditions of the UL series ratings including:
1. Size and type of upstream device
2. Branch devices that can be used
3. UL series short-circuit rating

2.03 CONSTRUCTION

A. Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

B. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner’s option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.

C. Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

D. Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.

E. A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.

F. All locks shall be keyed alike.

2.04 BUS

A. Main bus bars shall be copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

B. A system ground bus shall be included in all panels.

C. Full-size (100%-rated) insulated neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

2.05 BRANCH CIRCUIT PANELBOARDS

A. The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings. Panelboards shall be
series rated. Panelboards shall be Eaton type Pow-R-Line 1a, Pow-R-Line 2a or Pow-R-Line 3a.

B. Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

C. Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be UL listed as type SWD for lighting circuits.
   1. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

D. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes symmetrical at 240 volts, and 14,000 amperes symmetrical at 480 volts, unless otherwise noted on the drawings.

2.06 DISTRIBUTION PANELBOARDS – CIRCUIT BREAKER TYPE

A. Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings. Panelboards shall be series rated. Panelboards shall be Eaton type Pow-R-Line 3a or Pow-R-Line 4B. Panelboards shall have molded case circuit breakers as indicated below.

B. Where indicated, provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.

C. Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

2.07 ENCLOSURE

A. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

B. Enclosures shall be provided with blank ends.

C. Where indicated on the drawings, branch circuit panelboards shall be column width type.

2.08 NAMEPLATES

A. Provide an engraved nameplate for each panel section.
2.09 FINISH

A. Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray ANSI 61 paint applied.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.02 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

END OF SECTION
SECTION 26 27 01

ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Electrical Power Service System

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish service entrance conduit and cable and miscellaneous hardware required.

PART 3 EXECUTION

3.1 SERVICE

A. System is for the most part existing and commences at the existing pad-mounted transformer secondary and continues through the main switchboard, feeder circuits, panelboards, and branch circuits to wiring devices, appliances, apparatus, and other utilization equipment.

B. The existing service is 480Y/277 volts, three (3) phase, four (4) wire, solidly ground wye, from an existing pad-mounted transformer at the back of the building (South). Coordinate any outages or service modifications with JCPB and ETSU.

C. Metering is existing at the transformer secondary bushings.

END OF SECTION
PART 1  GENERAL

1.01 WORK INCLUDED

A. Switches

B. Receptacles

C. Plates

1.02 QUALITY ASSURANCE

A. Listing and Labeling: Provide wiring devices and plates that are listed and labeled.
   1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Wiring devices and plates and their installation shall comply with the requirements of the National Electrical Code.

PART 2  PRODUCTS

2.01 SWITCHES

A. Switches shall be toggle, quiet-type with totally enclosed with bodies of thermo-plastic and mounting strap.

B. Switches shall be rated for 20 amps, 277 volts AC. Switches shall be specification grade Hubbell, P&S, Leviton, Cooper Wiring Devices, or approved equal.

2.02 RECEPTACLES

A. Receptacles shall be general purpose, heavy duty, duplex receptacles made of thermoplastic supported on a metal mounting strap in accordance with NEMA WD 1. Receptacles shall be 20 amp, 125 volt, specification grade Cooper Wiring Devices, Hubbell, Leviton, P&S.

B. Ground fault circuit interrupter receptacles shall be the “feed-through” type rated to protect 20 amps. Receptacles shall be specification grade duplex receptacles with almond impact-resistant nylon face with test and reset buttons.
   1. 20 Amp, 125 Volt: Cooper Wiring Devices, Hubbell, Leviton, P&S,
or approved equal.

C. Special Receptacles: As indicated on Drawings, and including USB Charging type receptacles in public areas, corridors, and conference rooms.

2.03 PLATES

A. Provide UL listed, one-piece device plates to suit the devices installed.

B. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast-metal having round or beveled edges.

C. Plates on finished walls shall be nylon or thermoplastic, mid-size, unless noted otherwise. Plates in the kitchens/food service areas shall be stainless steel.

D. Plates shall be same color as receptacle or toggle switch with which they are mounted. Screws shall be machine-type with countersunk heads in color to match finish of plate.

E. Plates installed in wet locations shall be gasketed and UL listed for “wet locations” as per NEC 406.8 (B).

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide proper size outlet boxes for all wiring devices in accordance with Section 26.05.33, “Outlet and Junction Boxes.”

B. Install switches forty-eight (48") inches above finished floor on lock side and clear of door frame a minimum of three (3") inches unless otherwise noted. Prior to rough-in, coordinate with architectural drawings to determine lock side of door.

C. All switches shall be made by the same manufacturer.

D. Where two or more snap switches are to be installed at the same location, they shall be mounted in one-piece ganged switch boxes, with at gang cover plate.

E. Combination snap switch and single or duplex receptacles shall be mounted in two-gang switch box with one-piece device plate.

F. Receptacles shall be mounted 18" above finished floor unless otherwise noted.

G. All wiring devices shall be mounted in accordance with accessibility code requirements.
H. The color of all devices and plates shall be selected by the architect.

END OF SECTION
SECTION 26 28 13

DISCONNECT SWITCHES

PART 1  GENERAL

1.01 WORK INCLUDED

A. Fused Disconnect Switches

1.02 SUBMITTALS

A. Provide product data showing switch’s ratings and enclosure type

1.03 QUALITY ASSURANCE

A. Listing and Labeling: Provide disconnect switches that are listed and labeled.
   1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Disconnect switches and their installation shall comply with the requirements of the National Electrical Code.

PART 2  PRODUCTS

2.01 MANUFACTURERS

A. Switches shall be Eaton, or approved equal. Examples are Square D, General Electric, Siemens Energy & Automation.

2.02 MATERIALS

A. Use heavy-duty type for 600 volt switches. Switches shall have quick make, quick break, load interrupter, enclosed knife switch manufactured to the requirements of NEMA KS 1.

B. All switches shall have externally operable handles with interlocking covers to prevent opening front cover with switch in the ON position and have provisions for multiple padlocks in the OFF position.

C. Provide equipment ground lug in each switch.
D. Provide NEMA 1 enclosures for interior installations, unless otherwise noted.

E. Provide NEMA 3R enclosures for exterior installations or in wet locations, unless otherwise noted.

F. Provide fuses as per equipment manufacturer recommendation, dual-element, time-delay, current limiting, with blown fuse indicator site glass.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. Provide safety switches sized as indicated on the Drawings.

B. Mount individually enclosed switches plumb and level with top four (4') feet above floor or grade, unless otherwise noted.

C. Provide a set of fuses in fusible disconnect switches, as per equipment manufacturer recommendations.

3.02 IDENTIFICATION

A. Identify disconnect switches in accordance with Section 26 05 53, "Electrical Identification."

**END OF SECTION**
SECTION 26 32 13

GENERATOR SET

PART 1 GENERAL

1.01 SCOPE OF WORK

A. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.

B. Any and all substitutions shall be subject to the approval of the engineer.

C. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.

D. The equipment shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.

E. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.

1.02 GENERAL REQUIREMENTS

A. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.

B. All equipment shall be new and of current production by a national firm that manufactures the generator sets and controls, transfer switches, and switchgear, and assembles the generator sets as a complete and coordinated system. There will be one-source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.
1.03 SUBMITTAL

A. The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

1.04 CODES AND STANDARDS

A. The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed. The generator shall be EPA Certified.

B. The generator set shall conform to the requirements of the following codes and standards:
   2. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
   3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
   4. IEC8528 part 4, Control Systems for Generator Sets.
   5. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
   7. NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
   8. NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.

1.05 TESTING

A. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.

B. Design Prototype Tests. Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
1. Maximum power (kW) and (kVA) at 0.8 lagging PF.
2. Maximum motor starting (skVA) at 35% instantaneous voltage dip.
3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
4. Governor speed regulation under steady-state and transient conditions.
5. Voltage regulation and generator transient response.
6. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
7. Three-phase short circuit tests.
8. Alternator cooling air flow.
9. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
10. Endurance testing.

C. Final Production Tests. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
1. Single-step load pickup
2. Safety shutdown device testing
3. Rated Power @ 0.8 PF
4. Maximum power
5. Upon request, a witness test, or a certified test record sent prior to shipment.

D. Site Tests. The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
3. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
4. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.
5. On site minimum 4 hour load bank test with confirmed results of test in writing to A/E.
1.06 WARRANTY AND MAINTENANCE

A. The generator set shall include a five year comprehensive warranty to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of startup. Optional warranties shall be available upon request.

B. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner’s maintenance log of repairs made and function tests performed on all systems.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. The generator set shall be a Kohler/Caterpillar/Cummins equipment with a 130 degree rise (Standby) alternator, sized per plans. It shall provide kW/kVA rating as shown on plans when operating at 277/480 volts, 60 Hz, and 0.8 lagging power factor. The generator set shall be capable of this Standby 130°C rating while operating in an ambient condition of less than or equal to 90°F and a maximum elevation of at least 3,500 feet above sea level.

B. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying a minimum of TBD kVA as indicated on plans for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip i.e. engine, alternator, voltage regulator and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

C. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

2.02 ENGINE

A. The minimum X.X liter displacement engine shall deliver a minimum of XXX HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
1. Electronic isochronous governor capable of 0.5% steady-state frequency regulation.
2. 12-volt positive-engagement solenoid shift-starting motor.
3. 70-ampere automatic battery charging alternator with a solid-state voltage regulation.
4. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
5. Dry-type replaceable air cleaner elements for normal applications.
6. The engine shall be naturally aspirated and fueled by No. 2 Diesel
7. The engine shall have at least 8 cylinders and be liquid-cooled.

B. The generator must accept rated load in one-step.

C. The engine shall be EPA certified from the factory.

2.03 ALTERNATOR

A. The alternator shall be salient-pole, brushless, 2/3-pitch, 12 lead, self-ventilated with drip-proof construction and amortisseur rotor windings and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to Standby 130°C. The PMG excitation system shall be of brushless construction controlled by a digital, 3-phase sensing, solid-state voltage regulator capable of maintaining voltage within ±2.0% at any constant load from 0% to 100% of rating. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.

B. The alternator shall have a single maintenance-free bearing, designed for 40,000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

C. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.

2.04 CONTROLLER

A. Decision-Maker® 550 Controller (Kohler) or equal by Caterpillar or Cummins
1. The generator set controller shall meet NFPA 110 Level 1 requirements (1996 version) and shall include an integral alarm horn as required by NFPA.
2. The controller shall meet NFPA 99 and NEC requirements.
3. The controller shall be UL 508 listed.

B. Applicability
1. The controller shall be standard on a (to be determined).
2. The controller shall support 12 or 24 volt starting systems.
3. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
4. The controller shall mount on the generator or remotely within 40 feet with viewable access.

C. Hardware Requirements
1. Control Panel shall include:
   a. The control shall have a run-off/reset-auto three-position selector switch.
   b. A controller-mounted, latch-type emergency stop pushbutton.
   c. Five indicating lights: System Ready - green; Not in Auto - yellow; Programming Mode - yellow, System Warning - yellow; and System Shutdown - red.
   d. Display with two lines of 20-alphanumeric characters, viewable in all light conditions.
   e. Sixteen position snap action sealed keypad for menu selection and data entry.
   f. For ease of use, an operating guide shall be printed on the controller faceplate.
   g. An audible alarm with alarm silence capability.
   h. Panel lights shall be supplied as standard.

D. Control Functional Requirements
1. Field-programmable time delay for engine start. Adjustment range 0-5 minutes in 1 second increments.
2. Field-programmable time delay engine cool-down. Adjustment range 0-10 minutes in 1 second increments.
3. Capability to start and run at user-adjustable idle speed during warm-up for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM-equipped engine.
4. The idle function including engine cool down at idle speed.
5. Real-time clock and calendar for time stamping of events.
6. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds.
7. Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 59 Hz.
8. Programmable cyclic cranking that allows up to six crank cycles and up to 35 seconds of crank time per crank cycle.
9. The capability to reduce controller current battery draw, for
applications where no continuous battery charging is available. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.

10. Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.

11. Control logic with RMS digital voltage regulation. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems.

12. The capability to exercise the generator set by programming a running time into the controller. This feature shall also be programmable through the PC software.

13. Control function shall include output voltage adjustment.

14. Battle switch function selection to override normal fault shutdowns, except emergency stop and over-speed shutdown.

15. The control shall detect the following conditions and display on control panel:
   a. Customer programmed digital auxiliary input ON (any of the 21 inputs available)
   b. Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines)
   c. Emergency stop
   d. High coolant temperature
   e. High oil temperature
   f. Controller internal fault
   g. Locked rotor - fail to rotate
   h. Low coolant level
   i. Low oil pressure
   j. Master switch error
   k. NFPA common alarm
   l. Over-crank
   m. Over-speed with user-adjustable level, range 60-70 Hz.
   n. Over-voltage with user adjustable level, range 105% to 135%
   o. Over-frequency with user adjustable level, range 102% to 140%
   p. Under-frequency with user adjustable level, range 80% to 90%
   q. Under-voltage with user adjustable level, range 70% to 95%
   r. Coolant temperature signal loss
   s. Oil pressure gauge signal loss

16. Conditions resulting in generator warning (generator will continue to operate):
   a. Battery charger failure
   b. Customer programmed digital auxiliary input on (any of the 21 inputs available)
   c. Customer programmed analog auxiliary input on (any of
the 7 inputs available on ECM engines and 5 inputs for non ECM engines)

d. Power system supplying load
e. Ground fault detected - detection by others
f. High battery voltage - Level shall be user adjustable
g. Range 29-33 volts for 24-volt systems
h. High coolant temperature
i. Load shed
j. Loss of AC sensing
k. Under-frequency
l. Low battery voltage - level shall be user adjustable, range 20-25 volts for 24-volt systems.
m. Low coolant temperature
n. Low fuel level or pressure
o. Low oil pressure
p. NFPA common alarms
q. Over-current
r. Speed sensor fault
s. Weak battery
t. Alternator protection activated

E. Control Monitoring Requirements

1. All monitored functions must be viewable on the control panel display.

2. The following generator set functions shall be monitored:
   a. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
   b. All single phase and three phase currents, 0.25% accuracy
   c. Output frequency, 0.25% accuracy
   d. Power factor by phase with leading/lagging indication
   e. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
   f. kVARs total and per phase, 0.5% accuracy
   g. kVA total and per phase, 0.5% accuracy
   h. kW hours
   i. A display of percent generator set duty level (actual kW loading divided by the kW rating)

3. Engine parameters listed below shall be monitored: (*available with ECM equipped engines)
   a. Coolant temperature both in English and metric units
   b. Oil pressure in English and metric units
   c. Battery voltage
   d. RPM
   e. Lube oil temperature*
   f. Lube oil level*
   g. Crankcase pressure*
   h. Coolant level*
   i. Coolant pressure*
   j. Fuel pressure
k. Fuel temperature*
l. Fuel rate
m. Fuel used during the last run*
n. Ambient temperature*

4. Operational records shall be stored in the control beginning at system startup.
   a. Run time hours
   b. Run time loaded hours
   c. Run time unloaded hours
   d. Number of starts
   e. Factory test date
   f. Last run data including date, duration, and whether loaded or unloaded
   g. Run time kilowatt hours

5. The following operational records shall be a resettable for maintenance purposes:
   a. Run time hours
   b. Run time loaded hours
   c. Run time unloaded hours
   d. Run time kilowatt hours
   e. Days of operation
   f. Number of starts
   g. Start date after reset

6. The controller shall store the last one hundred generator set system events with date and time of the event.

7. For maintenance and service purposes, the controller shall store and display on demand the following information:
   a. Manufacturer's model and serial number
   b. Battery voltage
   c. Generator set kilowatt rating
   d. Rated current
   e. System voltage
   f. System frequency
   g. Number of phases

F. Inputs and Outputs
1. Inputs
   a. There shall be 21 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
   b. There shall be 7 user-programmable analog inputs for ECM-equipped engines (5 for non-ECM engines) for monitoring and control.
   c. Each analog input can accept 0-5 volt analog signals
   d. Resolution shall be 1:10,000
   e. Each input shall include range settings for 2 warnings and 2 shutdowns
   f. All values shall be on the control panel display.
   g. Shall be user-assigned.
h. Additional standard inputs required:
   • Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
   • Reset of system faults.
   • Remote two-wire start
   • Remote emergency stop
i. Idle mode enable.

2. Outputs
a. All NFPA 110 Level 1 outputs shall be available.
b. Thirty outputs shall be available for interfacing to other equipment:
   • All outputs shall be user-configurable from a list of 25 functions and faults.
   • These outputs shall drive optional dry contacts.
c. A programmable user-defined common fault output with over 40 selections shall be available.

G. Communications
1. Provide an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
2. Industry standard Mod-bus communication shall be available.
3. A Mod-bus master shall able to monitor and alter parameters, and start or stop a generator.
4. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows 2007 or later.
5. Communications shall be available for serial, CAN, and Ethernet bus networks.
6. A variety of connections shall be available based on requirements:
   a. A single control connection to a PC.
   b. Multiple controls on an intranet network connected to a PC.
   c. A single control connection to a PC via phone line.
   d. Multiple controls to a PC via phone line.
7. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.
8. The capability to connect up to 128 controls (any combination of generator sets and transfer switches) on a single network shall be supported.
9. Cabling shall not be limited to the controller location.
10. Network shall be self-powered.

2.05 ACCESSORIES

A. Battery Charger. A 10-ampere automatic float to equalize battery charger with the following features:

1. 12 or 24 VDC output
2. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
3. Ammeter and voltmeter with 5% full-scale accuracy
4. LED lamp for power indication
5. Current limited during engine cranking, short circuit, and reverse polarity conditions
6. Temperature compensated for ambient temperatures for -40°C to 60°C
7. UL Listed

B. Battery Rack and Cables. Battery rack and battery cables capable of holding the manufacturer’s recommended batteries shall be supplied.

C. Critical Silencer. The engine exhaust silencer shall be temperature and rust resistant, and rated for critical applications. The silencer will reduce total engine exhaust noise by 25-35 db(A).

D. Circuit Breaker No. 1. The generator shall come with a factory installed, 80% rated line circuit breakers rated per plans that are UL listed, and shall provide life safety (LS) output to the “LS” ATS unit.

E. If a fire pump is present, provide factory installed load side lugs for direct connection of fire pump per NEC and NFPA requirements. Load side lug connections made at the factory shall be separated from field connections.

F. Circuit Breaker No 2. The generator shall come with a second, factory installed, 80% rated line circuit breaker rated per the plans that is UL listed, and shall provide optional stand-by (SB) output to the “SB” ATS. Separators shall be installed at the factory between output breakers and lugs when multiple breakers and/or lugs are required. Load side breaker connections made at the factory shall be separated from field connections.

G. Dry Contact Kits. The 10 Dry Contact Kit shall provide normally open and normally closed, gold-plated contacts in a form C configuration to activate warning devices and other customer-provided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions.

H. Failure Relay.
1. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
2. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
3. Once energized the relay shall remain latched until the system is reset by the main controller switch.
I. Flex Exhaust Tube. The exhaust piping shall be gas proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.

J. Rodent Guards. Generator rodent guards shall prevent intrusion and protect internal components.

K. Run Relay. The run relay shall provide a three-pole, double-throw relay with 10-amp/250 VAC contacts to indicate that the generator is running. The relay provides three sets of dry contacts for energizing or de-energizing customer devices while the generator is running (e.g. louvers, indicator lamps, etc.)

L. Standard Air Cleaner. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

M. Block Heater. The block heater shall be thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.

N. Provide Sub-base fuel tank, Double Wall, with level and leak detection. Tank shall be belly type with 24 hour full-load fuel supply. Contractor shall leave tank completely full after all testing and commissioning of the unit.

O. Remote Annunciator. Provide a NFPA 110 Compliant remote annunciator which duplicates main controller alarm and status reporting. Locate in main electrical room or as directed by owner.

2.06 SOUND ENCLOSURE

A. The enclosure shall be constructed from high strength, low alloy steel, aluminum or galvanized steel.

B. The enclosure shall be finish coated with powder baked paint for superior finish, durability and appearance. Enclosures will be finished in the manufacturer's standard color.

C. The enclosure shall allow the generator set to operate at full load in an ambient of 40°C - 45°C with no additional de-rating of the electrical output.

D. The enclosure shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit
breaker must meet the requirements of the National Electric Code.

E. Doors must be hinged with stainless steel hinges and hardware and be removable.

F. Doors shall be equipped with lockable latches. Locks must be keyed alike.

G. A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.

H. The complete exhaust system shall be internal to the enclosure.

I. All acoustical insulation shall be fixed to the mounting surface with pressure sensitive adhesive or mechanically fastened. In addition, all acoustical insulation mounted on a horizontal plane shall be mechanically fastened. The acoustical insulation shall be flame retardant.

J. The enclosure shall include an exhaust scoop to direct the cooling air in a vertical direction.

K. Sound Attenuation Level shall be a maximum dB (a) level of 68 measured at 7 m or (23FT).

**PART 3 EXECUTION**

3.01 TESTING

A. Provide 4 hour load bank test on site per NFPA.

END OF SECTION
SECTION 26 36 00

AUTOMATIC TRANSFER SWITCHES

PART 1  GENERAL

1.01  SCOPE OF WORK

A. Furnish and install automatic transfer switch systems as indicated on drawings; 3 Pole or 4 Pole type and Ampacity as noted on drawings, 480Y277 Volt, 60Hz. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

1.02  CODES AND STANDARDS - The automatic transfer switches and controls shall conform to the requirements of:

A. UL 1008 - Standard for Transfer Switch Equipment
B. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment
C. NFPA 70 - National Electrical Code
D. NFPA 110 - Emergency and Standby Power Systems
E. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
F. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
G. UL508 Industrial Control Equipment
H. CSA C22.2 No. 178 certification

1.03  ACCEPTABLE MANUFACTURERS

A. Automatic transfer switches shall be Kohler/Caterpillar/Cummins/ASCO or equal, OPEN – TRANSITION, 4-POLE.

1.04  SERVICE REPRESENTATION

A. The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

PART 2 PRODUCTS

2.01 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held with double throw construction, and operated by a momentarily energized solenoid-driven mechanism. Main operators shall include overcurrent disconnect devices or linear motors.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.

G. The 4-pole switch shall be true open transition type, and phase conductors will break prior to neutral upon transition in both directions. All four poles will be open prior to transfer/re-transfer to destination source and neutral shall make prior to phase conductors.

2.02 ENCLOSURE

A. The ATS shall be furnished in a NEMA 1 enclosure.

B. All standard door mounted switches and long life super bright type indicating LEDs described in section 3 shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having manual locking feature to allow the user to lockout all membrane
mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

2.03 CONTROLLER DISPLAY AND KEYPAD

A. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the communications interface port. The following parameters shall only be adjustable via a password protected programming on the controller (dip switches shall not be acceptable):
   • Nominal line voltage and frequency
   • Single or three phase sensing
   • Operating parameter protection
   • Transfer operating mode configuration (Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.04 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING id-2-7

A. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dropout/Trip</th>
<th>Pickup/Reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under voltage</td>
<td>75 to 98%</td>
<td>85 to 100%</td>
</tr>
<tr>
<td>Over voltage</td>
<td>105 to 135%</td>
<td>95 to 100% of trip</td>
</tr>
<tr>
<td>Under frequency</td>
<td>85 to 99%</td>
<td>95 to 99%</td>
</tr>
<tr>
<td>Over frequency</td>
<td>105 to 120%</td>
<td>101 to 105%</td>
</tr>
<tr>
<td>Voltage unbalance</td>
<td>5 to 20%</td>
<td>3% to 18%</td>
</tr>
</tbody>
</table>

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 70°C.

C. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.

D. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via the communications interface port.

E. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation.
selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being defeated, if required.

F. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition shall be considered a failed source.

G. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

2.05 TIME DELAYS

A. An adjustable time delay of 0 to 10 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.

B. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.

The controller shall also include the following built-in time delays for the following operations:

1. 0 to 60 minute time delay on failure to acquire the acceptable electrical parameters from the emergency source.
2. 0 to 60 minute time delay for a failure to synchronize on an in-phase operation.
3. 60 minute time delay for the load disconnect position for delayed transition operation.

F. All time delays shall be adjustable in 1 second increments.

G. All time delays shall be adjustable by using the display and keypad or with a remote device connected to the communications interface port.
through a security-password system.

H. All time delays shall be adjustable by using the display and keypad or with a remote device connected to the communications interface port through a security-password system.

I. Each time delay shall be identified and a dynamic countdown shall be shown on the display.

2.06 ADDITIONAL FEATURES

A. The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.

B. Membrane-type switches shall be provided for the test functions and be maintained until the end test function is activated. The test function shall be allowed through password security. It shall be possible to defeat the password requirement by way of a circuit board mounted dip switch setting. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the emergency source fails and the normal source is acceptable.

C. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

D. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.

E. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

F. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.

G. A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.
H. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

I. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which closes to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or the communications interface port. A “not-in-auto” LED shall indicate anytime the controller is inhibiting transfer from occurring.

J. An in-phase monitor shall be a standard feature in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be capable of being enabled or disabled for the user interface. The in-phase monitor shall not be utilized as an alternative to open transition switching, shall only provide timing coordination between Normal – Open – Generator positions.

K. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
   1. Enable or disable the routine.
   2. Enable or disable transfer of the load during routine.
   3. Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every).
   4. Set the duration of the run.
   5. At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of exercise, time and date. The type of exercise and the time remaining shall be display when the exercise is active. It shall be possible of ending the exercise event with a single button push.

L. Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.

M. System Status - The controller shall have a default display the following on:
   1. System status
   2. Date, time and type of the next exercise event
   3. Average voltage of the preferred and standby sources

Scrolling through the displays shall indicate the following:
1. Line to line and line to neutral voltages for both sources
2. Frequency of each source
3. Load current for each phase
4. Single or three phase operation
5. Type of transition
6. Preferred source
7. Commit or no commit modes of operation
8. Source/source mode (Utility/Gen; Gen/Gen; Utility/Utility)
9. In phase monitor enable/disable
10. Phase rotation
11. Date and time

N. Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not permissible.

O. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

P. Communications Interface - The controller shall be capable of interfacing, through a standard communications with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration), an Ethernet connectivity (over standard 10baseT Ethernet networks utilizing a RJ-45 port or remotely utilizing a dial-up modem). This module shall allow for seamless integration of existing or new communication transfer devices and generators. Monitoring software shall allow for the viewing, control and setup of parameters of the genset and transfer switch network through a standard personal computer utilizing current Microsoft operating systems. Separate and specific transfer switch software interfaces shall not be acceptable.

Q. The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU and Modbus TCP/IP open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.

R. The controller shall contain a USB port for downloading the controller’s parameters and settings; exercise event schedules; maintenance records and event history. The file designator shall be the unique serial number of the transfer switch.

S. Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be downloadable to be displayed on a computer.

1. Event Logging
2. Statistical Data
   Total number of transfers.*
   Total number of fail to transfers.*
   Total number of transfers due to preferred source failure.*
   Total number of minutes of operation.*
   Total number of minutes in the standby source.*
   Total number of minutes not in the preferred source*
   Normal to emergency transfer time
   Emergency to normal transfer time
   System start date
   Last maintenance date

   * The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset

T. External DC Power Supply - An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

PART 3 EXECUTION

3.01 TESTS AND CERTIFICATION

A. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

B. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, and installation and servicing in accordance with ISO 9001.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. This specification describes the mechanical and electrical requirements for a transient voltage surge suppressor herein known and shown on all drawings as TVSS. The TVSS shall be suitable for application in category C3 environments as described in ANSI/IEEE C62.41. The TVSS shall be parallel design and provide protection: Line to Line, Line to Neutral, Neutral to Ground. “Series” type TVSS units will be deemed unacceptable.

1.02  SUBMITTALS

A. The contractor shall submit all related TVSS specifications, electrical and mechanical drawings, maintenance manuals, and UL 1449 surge suppression ratings, as well as Independent tests performed on the TVSS that show that the TVSS being submitted is capable of controlling >104kA 8/20 surge current.

1.03  QUALITY ASSURANCE

A. Only pre-approved TVSS products shall be accepted.

B. Manufacturer Qualifications: All TVSS units shall be manufactured by a firm that has manufactured TVSS products, for at least 10 years. Firms must also regularly engage in the manufacturing of TVSS products for Categories B3 (ANSI/IEEE 62.41) and C3.

C. Codes and Standards
   1. UL compliance and Labeling: Listed per UL 1449 3rd Edition.
   3. NEC compliance: Comply with 2008 NEC as applicable to construction and Article 280 for installation.
   4. The TVSS shall be capable of surviving 2,500 sequential category B3 and C3 surges without failure. Follow IEEE test procedures in C62.45.
   5. The TVSS shall be warranted for no less than 10 years and shall include free replacement in whole or in part during that 10 years for any reason of failure.

PART 2  PRODUCTS

2.01  MANUFACTURERS

A. Manufacturers: Subject to compliances with requirements, provide pre-
approved product by the following:
1. Atlantic Scientific Corporation
2. Current Technology
3. Advanced Protection Technologies
4. Square-D
5. Eaton

2.02 TVSS EQUIPMENT

A. Service Entrance Suppressor:
1. The surge protection device shall be connected to a 50A overcurrent device installed in the service entrance electrical equipment with leads as short as possible and not to exceed 18 inches (ideally 10 inches).
2. The surge protection devices shall be Atlantic Scientific Corporation Model ZoneMaster Plus 150 Series (Part # 1810(4)XCA) or approved equal and must include the following ratings and accessories:
   a. 150kA 8/20 per phase surge suppression capability.
   b. Unit shall be of modular design consisting of bolt on modules (plug in type will be unacceptable) utilizing large block 40mm MOVs. The use of multiple 20mm MOV’s in parallel will not be acceptable.
   d. A 200,000 AIC Ultra-safe fused disconnect.
   f. UL Listed 1283 Extended Power Range Filter.
   g. Multi Mode Surge counter that monitors surge current NOT voltage. Multi Mode surge counter must be able to monitor total normal mode surges, common mode, or surge currents on each individual phase.
   h. Normally Open / Normally Closed Form C Dry Contacts.
   i. Unit shall have “High Voltage” Neutral to Ground Module with Red LED indicator.
   j. Unit shall have BOTH mechanical indicator flags and green LED indicators to show status of protection for each module.
   k. All plastics shall be UL 94-V flame class rated.
   l. Housing shall be UL listed and CSA Certified.
3. Standard unit housings shall be non-metallic and meet NEMA 1, 2, 3, 3S, 4, 4X, 12 and 13 classifications.
4. Standard unit housings shall have a transparent front cover for complete visual inspection and monitoring the status of protection for each module, and onboard diagnostics, module configuration, and wiring configuration.
5. Standard unit warranty must be for at least 10 years and be stated in the manufacturer’s literature.
3.01 APPLICATION OF TVSS

A. General: Apply TVSS on the load side of the main disconnect at the electrical service entrance switchboard.

B. Coordinate system voltage, wiring configuration, and location as shown on project drawings.

3.02 INSTALLATION OF TVSS

A. Install the TVSS with #8 AWG conductors from the main service panel. The conductors are to be as short and straight as practically possible and shall not exceed 18 inches in length. The TVSS shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

END OF SECTION
SECTION 26 51 00
INTERIOR LIGHTING

PART 1  GENERAL

1.01  WORK INCLUDED

A. This Section includes interior lighting fixtures, lamps, ballasts, and accessories.

1.02  DEFINITIONS

A. Fixture: A complete lighting unit. Fixtures include lamps and parts required to distribute the light, position and protect lamps, and connect lamps to the power supply.

B. Luminaire: Fixture.

C. Average Life: The published time when 50 percent have failed and 50 percent have survived under normal conditions.

1.03  SUBMITTALS

Provide the following submittals:

A. Product data describing fixtures, lamps, and ballasts. Arrange product data for fixtures in order of fixture designation.

B. Shop drawings from manufacturers detailing nonstandard fixtures and indicating dimensions, weights, methods of field assembly, components, features, and accessories.

C. Maintenance data for products for inclusion in Operating and Maintenance Manual.

D. Provide complete set of fixture information and include in O&M Manuals.

1.04  QUALITY ASSURANCE

A. Listing and Labeling: Provide fixtures, ballasts, lamps, and emergency lighting units that are listed and labeled for their indicated use on the Project.

1. Special Listing and Labeling: Provide fixtures for use in damp or wet locations and recessed in combustible construction specifically listed and labeled for such use.

2. The term "Listed and Labeled": As defined in the 2008 National Electrical Code, Article 100.

3. Listing and Labeling Agency Qualification: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA
Regulation 1910.7.

B. Interior lighting fixtures, lamps, ballasts, and accessories and their installation shall comply with the requirements of the 2008 National Electrical Code.

C. Manufacturers Qualifications: Firms experienced in manufacturing fixtures that are similar to those indicated for this Project and that have a record of successful inservice performance.

D. Coordination of Fixtures With Ceiling: Coordinate fixture mounting hardware and trim with the ceiling system.

1.05 EXTRA MATERIALS

A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.
   1. Lamps: 10 lamps for each 100 of each type and rating installed. Furnish at least 1 of each type.
   2. Ballasts: 1 for each 100 of each type and rating installed. Furnish at least 1 of each type.
   3. Globes and Guards: 1 for each 20 of each type and rating installed. Furnish at least 1 of each type.

PART 2 PRODUCTS

2.01 FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs and sharp corners and edges

B. Sheet Metal Components: Steel, except as indicated. Components are formed and supported to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating and free from light leakage under operating conditions. Arrange to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position.

D. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass except as indicated.
   1. Plastic: Highly resistance to yellowing and other changes due to
aging, exposure to heat and UV radiation.
2. Lens Thickness: 0.125 inches, minimum.

2.02 LED & FLUORESCENT FIXTURES

A. Fixtures: Conform to UL 1570.
B. Ballasts: Conform to UL 935, "Fluorescent-Lamp Ballasts and LED Drivers."
   1. Certification: By Electrical Testing Laboratory (ETL).
   2. Type: Class P, high-power-factory type except as indicated otherwise.
   4. Voltage: Match connected circuits.
   1. Minimum Power Factor: 90 percent.
   2. Minimum Operating Frequency: 20,000 Hz.
   3. Harmonic Content of Ballast Current: Less than 10 percent.
D. Electromagnetic Interference Filters: Integral to the fixture assembly. Provide one filter for each ballast. Suppress electromagnetic interference as required by MIL-STD-461, "Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference."

2.03 LAMPS

A. Conform to ANSI Standards, C78 series applicable to each type of lamp.

2.04 FINISH

A. Steel Parts: Manufacturer's standard finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.
B. Other Parts: Manufacturer's standard finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and
approved shop drawings.

B. Support For Recessed and Semirecessed Fixtures: Install fixtures so they are supported independently from the suspended ceiling support system. Install fixture support rods or wires at a minimum of four rods or wires per fixture located not more than 6 inches from fixture corners.

1. Fixtures Smaller Than Ceiling Grid: Install a minimum of four (4) rods or wires for each fixture and locate at corner of the ceiling grid where the fixture is located. Do not support fixtures by ceiling acoustical panels.

2. Fixtures of Sizes Less Than Ceiling Grid: Center in the acoustical panel. Support fixtures independently with at least two (2) 3/4-inch metal channels spanning and secured to the ceiling tees.

3. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corners.

C. Lamping: Lamp units according to manufacturer’s instructions. Fluorescent and LED lamp sources shall have minimum CRI of 82.

3.02 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Give advance notice of dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting installation. Include the following in tests of emergency lighting equipment:

1. 1 ½ hour burn.

E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.03 ADJUSTING AND CLEANING

A. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION
SECTION 26.61.00

GENERAL LIGHTING PROVISIONS

PART 1  GENERAL

1.01  WORK INCLUDED

A.  Fixtures
B.  Controls
C.  Lamps
D.  Ballasts and Drivers
E.  Exterior Fixtures
F.  Emergency Lighting

1.02  SUBMITTALS

A.  Submit shop drawings and product data in accordance with Section 26.05.00.
B.  Submit shop drawings for luminaries showing pertinent physical characteristics and performance data.
C.  Submit samples of luminaries prior to final production at Engineer’s request on any proposed fixture substitution.
D.  Provide a complete set of fixture information and include in O&M Manuals.

PART 2  PRODUCTS

2.01  ACCEPTABLE MANUFACTURERS

A.  Provide fixtures as shown in the fixture schedule or approved equal.

2.02  FIXTURES

A.  Provide electronic drivers in all LED fixtures and programmable rapid start ballasts in all fluorescent lighting fixtures with less than 10% total harmonic distortion suitable for roof/floor or roof/ceiling fire rating indicated on architectural plans. Ballasts and drivers shall be Cree, Sylvania, Philips, Universal, Advance, or General Electric. Recessed LED and fluorescent lighting fixtures drivers and ballasts shall be provided with integral thermal protection.
B.  Provide rapid start lamps for all fluorescent fixtures. Lamps shall be
General Electric and 3,500 °K, CRI of 80 or better, unless specified otherwise.

2.03 CONTROLS

A. Time switches shall be Tork, Intermatic, or Paragon of types and quantity shown on Drawings.

2.04 EMERGENCY EGRESS LIGHTING UNITS AND EXIT SIGNS

A. Provide fully automatic operation on power failure. Units shall have integral battery back-up for 1½ hours per NFPA. Units shall be connected unswitched to lighting circuits.

PART 3 EXECUTION

3.01 GENERAL

A. Furnish, locate, and install fixtures as indicated on Drawings.

3.02 INSTALLATION

A. Mount fixtures as called for in schedule on Drawings. Determine type of ceiling to be installed in each space and furnish fixtures suitable for exact type, including roof/floor or ceiling/floor fire rated design. Recessed fixtures shall be supported from building structure.

B. Lighting fixtures shall be structurally supported. LED and Fluorescent fixtures mounted in the ceiling shall be attached to ceiling system as required by NEC 410-16(b). Surface mounted fixtures shall be supported from building structural system by rods or rods and clamps, or by fixture outlet box which in turn shall be supported by rods.

C. Receive, store, uncrate, and install light fixtures shown in schedule on drawings to be specified by others.

D. Adjust lighting fixtures to illuminate the intended area.

E. Wire recessed luminaries with Type THHN wire not smaller than No. 12.

F. Wire surface mounted luminaries with Type THHN wire not smaller than No. 12 from outlet boxes.

G. Locate no splice or tap within an arm or stem. Wire shall be continuous from splice in outlet box of building wiring system to lamp socket or ballast terminals.

END OF SECTION
SECTION 27 01 00
REFERENCE STANDARDS

PART 1 GENERAL

1.01 DESCRIPTION
A. Telecommunications systems shall be provided as indicated on drawings and as called for hereinafter.

1.02 REFERENCE STANDARDS
A. ETSU Communications Infrastructure Standard (CIS) policy 500.2, October 19, 2016.
D. ANSI/NECA/BICSCI-568, Standard for Installing Commercial Building Telecommunications Cable.
E. ANSI/TIA 569-D, Telecommunications Pathways and Spaces.
F. ANSI/TIA 568.0-D, Generic Telecommunications for Customer Premises Standard Series
   568.1-D Commercial Building Cabling
   568-C.2 Copper Cabling Components
   568-C.3 Fiber Cabling Components
   568-C.4 Coax Cabling Components
G. ANSI/TIA 606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.
H. ANSI J-STD-607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
I. ANSI/TIA 758-B, Customer owned Outside Plant Telecommunications Cabling Standard
J. ANSI/TIA-526, 7&14, Telecommunications Measurements of Optical Fiber Single and Multi Mode Power Loss
K. ANSI/TIA 310-D, Cabinets, Racks, Panels, and Associated Equipment.
L. FCC Part 68, Connection of Terminal Equipment to the Telephone Network.
M. ADA of 2010 and Telecommunications Act of 1996, Physically Impaired and Accessibility.


O. IEEE 8-2.11.xx Wireless LAN’s


R. ANSI/SCTE 77 Underground Enclosure Integrity

**PART 2**  **PRODUCTS (NOT USED)**

**PART 3**  **EXECUTION (NOT USED)**

END OF SECTION
PART 1 GENERAL

1.01 DESCRIPTION

A. Furnish and install telecommunications outside plant (OSP) facilities as indicated on drawings and set forth hereinafter.

1.01 REFERENCE STANDARDS

A. See section 27.01.00 REFERENCE STANDARDS.


D. ETSU Communications Infrastructure Standard (CIS) policy 500.2, October 19, 2016.


PART 2 PRODUCTS

2.01 MATERIALS

A. Inner Duct: MaxCell 3x3 (MXD3456), locatable and metallically detectable for OSP, with color ID.

B. Fiber Optic OSP Cable: Single Mode – Corning Altos OS2 XXXEU4-T4101D20 (black); Multimode (50um) - Corning Altos OM3 XXXTU4-T4180D20 (black); Multimode (62.5um) Corning Altos OM1 XXXKU4-T4130D20 (black); XXX=strand count. Equivalent cables by CommScope are also approved for use.

C. Copper OSP Cable: 50 Pair PE89 BSW (Buried Service Wire) Phone Cable-as manufactured by Essex or General Cable.

D. OSP Coax installation:
   1. OSP Coax shall be flooded type, CommScope PIII 500 JCASS (under 500ft), PIII 750 JCASS (over 500ft).
   2. Coax .500 Series Fitting shall be Gilbert GRS-500-CH-DU-03-T
   3. Coax .750 Series Fitting shall be Gilbert GRS-750-CH-DU-03-T
D. Handholes - Handhole lids shall be traffic rated (AASHTO H-20) with "Communications" logo on cover of lid. See ETSU CIS and ITS Design and Installation Guidelines for more information.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. Provide one (2) 3x3 "MaxCell" innerducts in each of the 4" conduits entering building from OSP system. Provide conduits over 1" not filled with MaxCell, install 3/8" nylon rope with a pull rating of 200lb or more. Conduits 1" or less, fill with polyline (Greenlee 430). Each MaxCell is to have different color ID marking and shall be locatable. The use of flexible plastic innerduct shall not be permitted.

B. The use of 90-degree bends shall be prohibited for OSP conduits. Long communications sweeps shall be utilized where conduit turns are required. Use Schedule 80 PVC, under sidewalks, driveways, etc. Use Schedule 40 PVC elsewhere. Conduit to be free of water and debris throughout. Provide caps on ends.

C. OSP conduits shall be marked with Detectable Warning Tape, CH Hansen 16626 or equal.

D. Handholes (HH) shall be 36"x60"x36D" minimum size, with open bottom (on top of 4" rack). Seal conduits at each HH to keep moisture, insects, and rodents out of building. Conduits entering building must be sloped. All Handholes where fiber splices are made shall be 36"x60"x36D" minimum. Use Quazite PG style with pull slot center pins, lid shall be labeled "COMMUNICATIONS".

E. All OSP cabling shall be installed in neat and workmanlike manner. Cabling to be routed and secured around edges of HH to create additional space for future cabling.

F. Provide 50 foot maintenance loop for fiber optic lines and 25 foot for copper lines in all HH. Service loops to side of HH.

G. Label all OSP cabling as follows:
   1. "Caution Fiber Optic" adhesive marker every HH. Label to include SM an MM fiber count and "to and from".
   2. "Caution Fiber Optic" adhesive marker every 50' of exposed fiber in building (including in cable tray). Label to include SM and MM fiber count and "to and from".
   3. OSP UTP cables shall be labeled with permanent, neat penmanship in every HH with "to and from".

H. Prior to backfill, contractor shall arrange for inspection of OSP installation with ETSU ITS Department.
I. Prior to commencing with work, a pre-construction meeting will be held between the contractor's telecommunications cabling installer and appropriate representatives of the ETSU Physical Plant, ITS Department. Installation requirements shall be carefully discussed at the pre-construction meeting. Discrepancies between contract documents and pre-construction meeting shall be called to the attention of Project Engineer immediately prior to commencing with any telecommunications installation work.

J. All conduit shall be installed such that the top of the conduit is a minimum of 24" below grade.

END OF SECTION
SECTION 27 05 29
HANGERS AND SUPPORT

PART 1 GENERAL

1.01 SCOPE OF WORK
A. Furnish and install a system of cabling supports above lay-in ceilings for network, voice, and CATV cabling as set forth hereinafter.

1.02 REFERENCE STANDARDS
A. See SECTION 27.01.00 REFERENCE STANDARDS

PART 2 PRODUCTS

2.01 MATERIALS
A. J-hooks shall be utilized above lay-in ceilings in individual rooms downstream of the cable tray for support of low-voltage cabling. J-hooks shall be as follows:
Use Panduit J-Pro Series non-metallic J-hooks for all horizontal cabling from outlet to cable tray. Steel J-hooks shall not be used.

B. Cabling support shall be located 4’ to 5’ on center throughout the entire length of network and CATV cabling runs above ceiling, once cable leaves cable tray. Provide separate sets of low-voltage cabling supports along entire length of low-voltage cabling runs above ceiling to allow separation of network cabling and CATV cabling. Network cabling shall be installed in separate J-hook support system from CATV cabling. Locate supports well clear of acoustical lay-in ceiling tiles. Supports shall be located such that tiles can be removed without interfering with support system. J-hook supports shall be secured directly to metal wall studs or masonry walls, as applicable. J-hooks shall not be attached directly to gyp-board walls. J-hooks shall be located no further apart than 5’0” on center along entire length of runs, with supports adjusted to be closer together as needed to attach to metal studs. A maximum of 8 Category 6 cables shall be installed per J-hook.

C. Provide cable tray as listed in ETSU CIS throughout corridor areas of the building for support of horizontal cabling runs originating in IDF communications rooms. 18” wide x 4” deep with trapeze type hangers 8 foot on center.

D. Provide all necessary supports and attachments to allow connection to structure for these supports. Provide all necessary conduits, raceways, cable trays, sleeves, etc. as necessary for the installation.

PART 3 EXECUTION
3.01 INSTALLATION

A. Entire installation shall be in accordance with manufacturer’s recommendations.

B. Cable tray shall be installed per manufacturer’s recommendations and shall be grounded. Cable tray shall be used for both CAT 6 and CATV cabling.

C. Provide two separate sets of low-voltage cabling supports along entire length of low-voltage cabling runs above ceiling, once leaving cable tray. One set of supports shall be of Category 6 network wiring. The second set of supports shall be for CATV wiring. Locate supports well clear of acoustical lay-in ceiling tiles. Supports shall be located such that tiles can be removed without interfering with support system.

D. Coordinate installation of low-voltage supports with other trades as required.

END OF SECTION
SECTION 27 05 53

ADMINISTRATION / LABELING

PART 1  GENERAL

1.01  DESCRIPTION

A. Provide administration and labeling of entire communications infrastructure in accordance with ETSU ITS Department requirements and as set forth hereinafter. Administration and labeling shall include but not be limited to all work area outlets (WAO's), patch panels, 110 blocks, conduits, cable trays, backbone cables, etc.

1.02  REFERENCE STANDARDS

A. See SECTION 27.01.00 REFERENCE STANDARDS

PART 2  PRODUCTS

2.01  MATERIALS

A. Products shall be as set forth elsewhere in these specifications.

PART 3  EXECUTION

3.01  INSTALLATION

A. All WAO's, patch panels, 110 blocks, conduits, cable trays, backbone cabling, outside plant cabling, etc., shall be labeled according to ANSI/TIA/EIA Standards with specific labeling scheme of ETSU OIT Department. Labeling is also to include the following:

1. "Caution Fiber Optic" adhesive marker every 20’ of exposed fiber in building (including in cable tray). Label to include SM and MM fiber count and "to and from".

END OF SECTION
SECTION 27 11 10

TELECOMMUNICATIONS SPACES

PART 1  GENERAL

1.01  DESCRIPTION

A.  Telecommunications spaces shall be provided as indicated on drawings and as called for hereinafter. Telecommunications spaces shall consist of equipment rooms (ER).

1.02  REFERENCE STANDARDS

A.  See section 27.01.00 for standards.

PART 2  PRODUCTS

2.01  MATERIALS

A.  ER layouts shall include network racks, vertical wire management, cable trays, and associated facilities. Each ER shall include, but not be limited to, the following equipment:

1.  Equipment Racks in Main IT/MDF Room shall be Hubbell No. CS1976, 84" x 19" with VS86 6" Z channel vertical wire management or equivalent. Provide a Hubbell RKTGB grounding bus bar in each equipment room. Provide a Hubbell MCCPSS19TS surge protected power strip for each network rack. Provide cable management components at each rack including Hubbell HC219CE3N (2 per patch panel) horizontal management, Hubbell MCCPSR4 cable management rings, and Hubbell 110RA cable management troughs. Provide Hubbell MCCCS19P equipment shelves. Provide Chatsworth 10605-019 rack base insulator kit.

2.  Equipment Racks in TR/IDF Rooms shall be Hubbell No. HPW96RR19, 96" x 19" with (2) VS86 6" Z channel vertical wire management or equivalent. Provide a Hubbell RKTGB grounding bus bar in each equipment room. Provide a Hubbell MCCPSS19TS surge protected power strip for each relay rack. Provide cable management components at each rack including Hubbell HC219CE3N (2 per patch panel) horizontal management, Hubbell MCCPSR4 cable management rings, and Hubbell 110RA cable management troughs. Provide Hubbell MCCCS19P equipment shelves. Provide Chatsworth 10605-019 rack base insulator kit.


4.  Cable Tray: In each ER room, provide 18" wide cable tray around room and to each rack. Cable tray shall be Hubbell Next Frame 18" "HL" Series or Cooper B-Line SB17U18B.

5.  Plywood Backboards: All walls of each ER room shall be provided
with 3/4" AC grade plywood, covered on all six sides with two coats of Benjamin Moore M59-220 (white) paint, with up to 2 ounces of tint allowed per gallon.

6. All fiber, OSP and Riser shall be terminated

**PART 3 EXECUTION**

3.01 INSTALLATION

A. Furnish and install at each ER location a grounding conductor from grounding bus in local ER Room AC panelboard to grounding bus bar mentioned in 2.01, A, Materials. Grounding conductors shall be copper, with "THHN/THWN" insulation, with green tape marking to indicate grounding conductor. Refer to drawings for grounding conductor sizes. Grounding and bonding shall be in accordance with BICSI TDMM current edition, Chapter 8, and NFPA 70.

B. Before any terminations and installation of equipment, the ER must be in finished stage, free of dust and debris with all walls and ceilings painted to finish coats and finished flooring installed and treated. After terminations and equipment are installed, contractor shall keep ER room door closed and locked at all times.

END OF SECTION
SECTION 27 15 00

VOICE AND NETWORK HORIZONTAL CABLING SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

A. Furnish and install voice and network cabling for the building as indicated on drawings and as called for hereinafter. This specification is for a voice and network cabling system. Products specified hereinafter are Hubbell, Mohawk, CommScope, or Belden cable and Hubbell connectivity including jacks, patch panels, patch cords, and faceplates shall be utilized. The Hitachi/Hubbell products specified hereinafter are utilized as campus standard for ETSU. Any proposed replacement products must meet or exceed the published specifications. Alternates must be verified with ETSU ITS by furnishing proper documentation of specifications verified by an industry-recognized test laboratory (U.L., ETL, ASTM).

B. This standard also establishes performance criteria for various system configurations and their elements.

C. Cabling contractor must maintain a full time RCDD on staff as project manager for this project. Field installers of cabling installation specified herein must be a certified trained installer using ANSI TIA Standards and the current edition of the BICSI TDMM (Telecommunications Distribution Methods Manual) as a guide for installation of inside cabling and associated components. Installer must be Hubbell Certified. Provide written documentation of these qualifications as part of the submittal process.

1.02 CABLEING STRUCTURE

A. The elements of a cabling system are listed below:

1. Horizontal Cabling
2. Work Area Outlets (WAO)
3. ER Rooms (See Section 27.11. 00)

B. HORIZONTAL CABLEING

1. Horizontal cabling shall be of star topology, each work area connector shall be terminated in the telecommunications room. The maximum horizontal distance from ER to the WAO shall be 90 meters. When deductions are made for mandatory minimum slack, the cable distance is approximately 85 meters (281 feet).

2. The amount of untwisting of individual pairs to terminate shall be less than or equal to .5 in. for Category 6.

3. Minimum bend radius shall be 4 times the cable diameter.

C. REFERENCE STANDARDS

1. See Section 27.01.00 REFERENCE STANDARDS
D. ADMINISTRATION STANDARD FOR COMMUNICATIONS INFRASTRUCTURE:

1. Purpose: The purpose of this standard is to provide a uniform administration scheme that is independent of the applications. This standard defines guidelines for contractors involved in the installation of the computer cabling system.

2. Scope: This standard specifies the administrative requirements of the communications infrastructure within a building or campus.

3. Areas to be administered are as follows:
   a. Terminations for the communications media
   b. Communications media between terminations
   c. Pathways between terminations
   d. Spaces where terminations are located
   e. Bonding and grounding

4. Pathway and Space Administration: All spaces must be labeled. Labels should be affixed at the entrance of the space.

5. Wiring System Administration: This section describes the administration of cables, termination hardware, splices and termination position. As changes are made, effected labels, records, drawings and reports shall be updated.
   a. Horizontal and backbone subsystem cables shall be labeled at each end. Each termination hardware or label shall be marked with an identifier.
   b. Each termination position label shall be recorded with an identifier.
   c. Each splice closure or label shall be marked with an identifier.
   d. "TMGB" shall be marked on the Telecommunications Main Grounding Busbar and the Bonding conductors from the TMGB to the TGB locations.

E. LABELING AND COLOR CODING:

1. Labels are divided into 3 categories:
   a. Adhesive labels shall meet adhesion, defacement and legibility requirements defined in U.L. 969. Labels shall also meet exposure requirements in U.L. 969.
   b. Insert labels shall also meet U.L. 969 requirements for defacement, legibility and general exposure.
   c. Other labels include special purpose labels, such as tie-on labels.
   d. Labels shall be used instead of marking the cable.

2. Refer to ITS Guidelines, Appendix M

F. COLOR CODING RULES:

1. Termination labels at the two ends of the cable shall be of the same color.

2. Cross-connectors made between termination fields are generally of two different colors.

3. The color orange is used for the demarcation point.

4. Green is for the network connections on the customer side of the
demarcation point.
5. Purple is for the termination of cables originating from common equipment.
6. White is for the first level backbone media.
7. Gray is for the second level backbone.
8. Blue is for the termination of station telecommunicators media.
9. Brown is for inter-building backbone cable terminations.
10. Yellow is for termination of auxiliary circuits, alarms, security, and other miscellaneous circuits.

G. DIFFERENTIATION OF TERMINATION FIELDS BY PERFORMANCE CATEGORY
1. If cables are of different performance classes, their ends should indicate the difference. The labels shall be marked with the proper category of the cable.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Wall-Station Jacks:
1. Network: Hubbell Speedgain, orange, HXJ6OR.

B. Wall-Station Faceplates: Wall station faceplates in office areas shall be Hubbell AFPI4EI Series with four port angled plate, color to match electrical outlets. All unused ports shall be provided with blank inserts, Hubbell SFBE10 Series. Provide blank inserts as required.

C. Equipment Racks: See Section 27.11.10.

D. ER Cable Tray: See Section 27.11.10.

E. Voice and network horizontal cabling: Cabling shall be as specified in ITS Guidelines, Appendix A. All network cable shall have blue outer insulation. Leave 8" of slack for each termination at wall outlet location. Leave one meter (3.28') slack at the end of each conduit run. Cable slack shall not be stored in bundled loops. Cable slack shall be stored in an extended loop or in a Figure 8 configuration. Provide two data cables to each communications outlet illustrated on the drawings, unless noted otherwise.

F. Patch Cords: Provide 6' grey patch cords to the ETSU ITS department. The patch cords shall be Hubbell model number PSX6GY. Provide one cable per patch panel port.

G. Backbone Voice Cable: Provide 50 twisted pair Cat 3 UTP riser as indicated on drawings. Backbone voice cable shall be terminated on plywood with 110, 5-pair blocks. Provide 110 troughs between backbone and horizontal 110 blocks. Use Mohawk M58522.

H. Backbone Fiber Optic Riser Cable: Single Mode – Corning MIC DX Armored Cable OS2 XXXE81-33131-DI (yellow); Multimode (50um) –
Corning MIC DX Armored Cable OM3 XXXT81-33180-DI (aqua); Multimode (62.5um) - Corning MIC DX Armored Cable OM1 XXXK81-31130-DI (orange); XXX=strand count. All fiber shall be terminated in fiber hubs per ETUS ITS standards.

I. Firestopping: Hilti CP-618 putty shall be installed inside the conduits and FS One or CP-653 re-entry sleeve shall be used outside and around the conduits.

**PART 3  EXECUTION**

3.01 INTERIOR BUILDING INSTALLATION:

A. Installation of all voice and network wiring facilities shall be by personnel regularly engaged in the installation of local area network cabling.

B. All wiring shall be color coded and terminated. All cabling shall be Cat 6 terminated to T568A wiring scheme. All network cabling shall have blue outer insulation.

C. Submit shop drawings for approval.

D. Testing shall conform to ANSI/TIA-568-B.1 standard. Testing shall be accomplished using a Hubbell approved tester. Include tester calibration date. Refer to ITS CIS for Commissioning, Warranties, and Documentation.

E. All testing shall meet or exceed manufacturer’s recommendation for 25-year warranty program.

F. Test each pair and shield of each cable for opens, shorts, grounds, and pair reversal. Correct grounded and reversed pairs. If horizontal cable contains bad conductors or shield, remove and replace cable. Cable shall have no visible defects such as twist, kinks, and dents.

G. During installation of cabling, the bend radius of cables is not to be less than the manufacturer's specific recommendation. Minimum bend radius shall be 10 times the diameter of the cable for fiber optic cable, and 4 times the diameter of the cable for copper cable. Contractor shall take and precaution not to exceed maximum tensile rating of cabling during installation.

H. Each horizontal cabling run shall include 10' of slack at telecommunications room end and 8” of slack at the outlet end. There shall also be one meter (3.28”) of slack above each wall outlet. Station cables in the telecommunications rooms can be stored in a “Figure 8” configuration to maintain the proper bend radius and provide the needed slack.

I. Labeling of cables, wall outlets, 110 blocks, conduits, cable trays, patch panels, and backbone cabling shall be performed in accordance with requirements of the ETSU ITS Department.
J. Building Automation System (BAS) Connection: Cabling connecting BAS to the ETSU ITS network must follow the standards set forth in ANSI/TIA 862.

K. Contractor shall provide all required fire-stopping of rated penetrations as required by these construction documents, applicable codes, and as required in the ETSU CIS.

L. Contractor shall provide all required bonding and grounding for telecommunications systems as required by these construction documents, applicable codes, and as required in the ETSU CIS.

**PART 4 QUALITY ASSURANCE**

4.01 QUALITY ASSURANCE:

A. Any contractor or subcontractor directly performing construction of these passive cabling systems shall maintain qualifications as detailed below for the duration of the project:

   1. **RCDD-of-Record Requirements**
      a. The contractor or subcontractor performing construction shall maintain a BICSI Registered Communications Distribution Designer (RCDD-of-Record) overseeing the scope of work. He or she shall be a current Registered Communications Distribution Designer in good standing as awarded by BICSI from time of bid through project’s substantial completion.
      b. The RCDD-of-Record shall be a permanent employee (not subcontractor or temporary employee) of the contractor or subcontractor performing construction.
      c. The RCDD-of-Record shall submit a current and valid copy of both their RCDD certificate as well as proof of employment by the contractor or subcontractor.
      d. The Designer shall coordinate all inspections with ETSU and the RCDD-of-Record. ETSU shall be notified a minimum of ten (10) business days in advance of the final inspection to give ample time to make accommodations to participate if so desired.
      e. In addition the contractor shall have a current and active Hubbell product certification as referenced later in this document.

**PART 5 - SUBMITTALS**

5.01 SUBMITTAL REQUIREMENTS

A. All submittals shall be provided to ETSU in their entirely (including re-submittals) in both printed and PDF formats.

B. Submittals are required to be provided to ETSU for all materials to be provided/installed/fabricated. All pre-construction submittals must be
approved by both the designer and ETSU prior to acquisition, installation or construction.

C. The following submittals are due in the Pre-Construction Phase
   1. Product Information
      a. Provide cover sheet showing project number, name, and description. Include table of contents with all product names, manufacturer, and specific product number identified.
      b. Materials and their manufacturer(s) part numbers shall be clearly called out for each item using a black arrow or circle. No highlighted submittals will be accepted.
   2. Provide scaled plan and elevation drawings of the proposed layout and construction of all components in all telecommunications rooms (scale to be not less than 1/4" = 1'-0") indicating locations of bus-bars, racks, ladder rack, service loops, wall mounted equipment, etc.

D. The following submittals are due at Substantial Completion
   1. Record Drawings (as-built drawings)
      a. Provide scaled drawings (floor plans not less than 1/16" = 1'-0") indicating actual location and size/length of TMGB, TGBs and TBB conductors and all splice points. Also to be included are all communications outlets and other points of termination including labeling and identification.
      b. Provide scaled plan and elevation drawings of telecommunications rooms (not less than 1/4" = 1'-0") indicating actual locations of TMGB and TGBs.
   2. Provide a letter from the contractors Project RCDD stating that the grounding system has been installed in accordance with the project documents and the referenced codes, standards, and guidelines.

END OF SECTION
SECTION 27 15 33

COAX HORIZONTAL CABLING

PART 1 GENERAL

1.01 DESCRIPTION

A. Furnish and install a complete a 1 GHz CATV wiring system as described on drawings and called for hereinafter.

B. The catalog numbers specified herein are those of the Blonder-Tongue Company and constitute the type and quality of the products to be installed.

C. The quality and type of CATV materials must be accepted by industry standards. All passive and active equipment must be two-way and pass signals up to one GHZ “passive” and 750 MHZ “active”.

1.02 INSTALLER QUALIFICATIONS

A. Installation of CATV cabling system shall be done by personnel regularly engaged in installation of such facilities. Installers shall have NCTI, SCTE, and BICSI certifications. Provide documentation of these certifications as part of the submittal process. Installer shall have working knowledge of all codes/standards related to CATV wiring installation.

1.03 DISTRIBUTION LEVELS

A. Line extender outputs shall be 46/40 DBMV for single cascade, and 43/37 DBMV for two cascades. No more than two line extenders shall be provided in cascade. Tap levels shall not exceed 17 DBMV on any “F” fitting. Typical tap level shall be 12 DBMV. Output level at faceplate shall be 3 DBMV and maximum of 10 DBMV. Maximum 3 DB variation shall be allowed between adjacent channels.

1.04 REFERENCE STANDARDS

A. SECTION 27.01.00 – REFERENCE STANDARDS

B. ANSI/SCE 74 2003, Specification for braided 75 ohm Flexible Coaxial Cable.

C. FCC Part 76, Cable Television Service.

PART 2 PRODUCTS

2.01 MATERIALS

A. Splitters: In the Telecommunications Room, Install splitters to take the cable TV feed and distribute it to each individual room.
Splitters/combiners shall be vertical ports, capable of passing one GHZ signal with built-in grounding lug, Truespec DSVXG or equivalent. “X” represents the number of ports. Arrange splitters/combiners so that signal is evenly distributed among all ports.

B. Wall Plates: Wall plates for CATV outlets shall be flush mounted with single-gang Standard F81 through connector with 0 db isolation, and one data jack, Hubbell AFP14EI.

C. Coaxial Cable: Coaxial cable shall be installed from each television outlet location shown on drawings to the Telecommunications Room on a homerun basis. No series wiring for TV shall be permitted. The coaxial cable from the outlet to the Telecommunications Room shall be Belden 7915A Series RG6 cable, aluminum braid shield, flame retardant PVC jacket meeting NEC Article 820V rating, ETL listed or equivalent.

D. Coaxial Connectors: Use compression type, Belden Thomas and Betts FSNS6U.

E. Amplifier: Provide one amplifier in Telecommunications Room. Each amplifier shall be two-way broadband distribution amplifier, Blonder-Tongue Model No. BIDA-750-30 or 750-50 as directed by ITS.

F. Riser Coax installation:
   1. Riser Coax shall be RG11 Belden 9011 if under 300 feet and Comscope PIII 500 Plenum over 300ft.
   2. RG11 Fitting shall be Thomas and Betts 716SNS1P11H
   3. Coax .500 Series Fitting shall be Gilbert GRS-500-CH-DU-03-T

**PART 3 EXECUTION**

3.01 INSTALLATION

A. Each coaxial cable shall be tested for signal loss, length of cable, and meet the manufacturers specifications. Testing shall be in accordance with FCC Part 76 signal leakage requirements. Coaxial cable tests will involve continuity and RF leakage, 20-uV/m leakage limit (10 feet from network). Limit will yield a dipole level of -43.67 dBmV 75 ohms. Carefully coordinate tie-in of incoming line with local cable operator. Complete TV feed to each individual outlet to verify that a proper signal is being distributed. After proper documentation disconnect each room at the headend location and make each connection for proper identification.

B. Cable drops shall be bundled by use of approved plastic ties. Tape shall not be permitted to bundle cable drops.

C. Grounding will meet NEC requirements for CATV. Refer to Article 820 of National Electrical Code for information.

**END OF SECTION**
SECTION 28 03 00
FIRE ALARM SYSTEM

PART 1  GENERAL

1.01  SUMMARY

A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.

C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
   1. Fire alarm and detection operations
   2. Control and monitoring of elevators, smoke control equipment, door hold-open devices, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.
   3. One-way supervised automatic voice alarm operations.

1.02  ACCEPTABLE MANUFACTURERS

A. Manufacturers: The equipment and service described in this specification are those supplied and supported by SimplexGrinnell and represent the base bid for the equipment. Equal equipment from Notifier will be considered.

1.03  RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:
   1. Division 26: "Basic Electrical Materials and Methods."
   2. Division 26: "Wiring Methods."
   3. Division 21: "Fire Protection"
   4. Division 23: "HVAC Systems"

C. The system and all associated operations shall be in accordance with the following:
   1. Guidelines of the following Building Code: BOCA
   2. NFPA 72, National Fire Alarm Code
   3. NFPA 70, National Electrical Code
5. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
6. Other applicable NFPA standards
7. Local Jurisdictional Adopted Codes and Standards
8. ADA Accessibility Guidelines

1.04 SYSTEM DESCRIPTION

A. General: Provide a complete, non-coded, addressable microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein. Connect the new fire alarm panel to the existing token and ring fire alarm network via fiber optic cable, make any and all fiber connections necessary for a complete fire alarm network.

B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory. System shall be capable of storing dual configuration programs with one active and one in reserve. Panel shall be capable of full system operation during a new configuration download.

C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

D. Recording of Events: Record all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout differentiates alarm signals from all other printed indications.

E. Wiring/Signal Transmission:
1. Transmission shall be hard-wired, using separate individual circuits for each zone of alarm operation as required or addressable signal transmission, dedicated to fire alarm service only.
2. System connections for initiating (signaling) circuits and notification appliance circuits shall be Class B.
3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone.

F. Remote Access:
1. FACP shall have the capability to provide Remote Access through a Dial-Up Service Modem using the public switched telephone system of a private switched telephone system.
2. A personal computer or technician’s laptop, configured with
terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.

3. FACP shall have the capability to provide Remote Access through a listed Internet Interface via a standard web browser user interface.

G. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.

2. Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent activations.

3. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter provided under another contract.

4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciator, indicating the location and type of device.

5. General Alarm: A system general alarm shall include:
   a. Indication of alarm condition at the FACP and annunciator(s).
   b. Identification of the device or zone that is the source of the alarm at the FACP.
   c. Operation of audible and visible notification devices throughout the building until silenced at FACP.
   d. Closing doors normally held open by magnetic door holders.
   e. Unlocking designated doors.
   f. Shutting down supply and return fans serving zone where alarm is initiated.
   g. Closing smoke dampers on system serving zone where alarm is initiated.
   h. Initiation of smoke control sequence through the building temperature control system.
   i. Notifying the local fire department.
   j. Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified detectors or sensors are activated.

6. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
   a. Activate the system supervisory service audible signal and
illuminate the LED at the control unit and the graphic annunciator.

b. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.

c. Record the event in the FACP historical log.

d. Transmission of supervisory signal to remote central station.

e. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.

8. System Reset

a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."

b. Should an alarm condition continue, the system will remain in an alarmed state.

9. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

10. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:

a. The city circuit connection and suppression release circuits shall be bypassed for the testing group.

b. Control relay functions associated to one of the 8 testing groups shall be bypassed.

c. The control unit shall indicate a trouble condition.

d. The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a voice announcement code to identify the device or zone.

e. The unit shall automatically reset itself after signaling is complete.

f. Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to voice announce sound for 4 seconds indicating the trouble condition.

H. Analog Smoke Sensors:

1. Monitoring: FACP shall individually monitor sensors for calibration,
sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.

2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.

4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a CRT Display or printed for annual recording and logging of the calibration maintenance schedule.

5. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to indicate that a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate that a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a dirty sensor without creating a trouble in the system. If this indicator is ignored, a second level "DIRTY SENSOR" condition shall be indicated at the FACP and subsequently a system trouble is reported. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.

6. The FACP shall continuously perform an automatic self-test on each sensor which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

7. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

8. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.

9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

I. Smoke Detectors: A maintenance and testing service providing the following shall be included with the base bid:
1. Biannual sensitivity reading and logging for each smoke sensor.
2. Scheduled biannual threshold adjustments to maintain proper sensitivity for each smoke sensor.
3. Threshold adjustment to any smoke sensor that has alarmed the system without the presence of particles of combustion.
4. Scheduled biannual cleaning or replacement of each smoke detector or sensor within the system.
5. Semi-annual functional testing of each smoke detector or sensor using the manufacturer’s calibrated test tool.
6. Written documentation of all testing, cleaning, replacing, threshold adjustment, and sensitivity reading for each smoke detector or sensor device within the system.
7. The initial service included in the bid price shall provide the above listed procedures for a period of five years after owner acceptance of the system.

J. Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.
   1. Automatic Voice Evacuation Sequence:
      a. The audio alarm signal shall consist of an alarm tone for a maximum of five seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.
      b. All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

K. Speaker: Speaker notification appliances shall be listed to UL 1480.
   1. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire.
   2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.
   3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.

L. Manual Voice Paging
   1. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group.
   2. The control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers.
   3. Facility for total building paging shall be accomplished by the means of an "All Call" switch.

M. Fire Suppression Monitoring:
   1. Water flow: Activation of a water flow switch shall initiate general
alarm operations.

2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.

3. WSO: Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

N. Power Requirements

1. The control unit shall receive AC power via a dedicated fused disconnect circuit.

2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.

4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously while incoming power is present.

5. The system batteries shall be supervised so that a low battery or depleted battery condition or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.

6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.

7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

8. Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

1.05 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Wiring diagrams from manufacturer.

3. Shop drawings showing system details including location of
FACP, all devices, circuiting and details of graphic annunciator. 
4. System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per UL and NFPA standards. 
5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, NAC, relay, sensor, and auxiliary control circuits. 
6. Operating instructions for FACP. 
7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations. 
8. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements. 
9. Record of field tests of system. 

B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions if required to make clarifications or revisions to obtain approval. 

1.06 QUALITY ASSURANCE 
A. Installer Qualifications: A factory authorized installer is to perform the work of this section. 
B. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label. 

1.07 MAINTENANCE SERVICE 
A. Maintenance Service Contract: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives. 
B. Basic Services: Systematic, routine maintenance visits on a quarterly basis at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.
C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

**PART 2 PRODUCTS**

2.01 FIRE ALARM CONTROL PANEL (SIMPLEX 4100-9111)

A. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."

B. The following FACP hardware shall be provided:
1. Power Limited base panel with beige cabinet and door, 120 VAC input power.
2. 2,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
3. 2,000 points of Network Annunciation at FACP Display when applied as a Network Node
4. 2000 points of annunciation where one (1) point of annunciation equals:
   a. 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
   b. 1 LED on panel or 1 switch on panel.
5. From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FCP LCD Display.
6. Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output.
7. One Auxiliary electronically resetable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
8. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
9. Where required provide Intelligent Remote Battery Charger for charging up to 110Ah batteries.
10. Power Supplies with integral intelligent Notification Appliance Circuit Class B for system expansion.
11. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
12. The FACP shall support (6) RS-232-C ports and one service port.
13. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
14. Programmable DACT for either Common Event Reporting or per Point Reporting.
15. Service Port Modem for dial in passcode access to all fire control panel information.
C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.

D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

E. Voice Alarm: Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:
1. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface.
2. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.
3. Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone.

F. Fiber Optic Modem: Network communications shall be via Simplex 4100U Fiber Optic Modems. The fiber modems shall allow Full Duplex/Bi-Directional Network and Audio Communications over a single Fiber Optic Cable. Modems shall use Type ST fiber connections. Modems shall use Multi-Mode 62.5 micron fiber cable. Fiber transmission shall be via split frequency utilizing 1310nm and 1550nm. 4100-6074 Left Port Fiber Modem Assembly, and 4100-6075 Right Port Fiber Modem Assembly.

2.02 REMOTE CRTS, PC ANNUNCIATOR AND PRINTERS

A. Fire Alarm Control Unit shall be capable of operating remote CRT’s and/or printers; output shall be ASCII from an RS-232-C connection with an adjustable baud rate.

B. Fire Alarm Control Unit shall be capable of operating a PC Annunciator which provides status annunciation and limited system control using a convenient and familiar Microsoft Windows® 2000 operating system based interface. PC Annunciator shall provide the following functions:
1. Login/logout password protection with time duration selectable automatic logout
2. Displays Alarm, Supervisory, Priority 2, and Trouble conditions with numerical tallies for each
3. Displays first and last alarms
4. Different event types have separate visible indicators with a common audible indicator
5. Event logs can be searched and printed
6. View and/or print TrueAlarm status reports and service reports (printing requires an available local or network printer)
7. Alarm Silence; System Reset; and Priority 2 Reset
8. Global and individual point acknowledge
9. Set system time and date; and clear event log
10. Individual point access for control or parameter revisions

C. Each RS-232-C port shall be capable of supporting and supervising a remote Printer; the FACP shall support as many as two (2) remote displays. The Fire Alarm Control Panel shall support five (5) RS-232-C ports.

2.03 REMOTE LCD ANNUNCIATOR (SIMPLEX 4603-9101)

A. Provide Remote LCD Annunciator with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.

B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.

C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

E. The LCD shall display the following information relative to the abnormal condition of a point in the system.
   1. 40 character custom location label.
   2. Type of device (e.g., smoke, pull station,水流).
   3. Point status (e.g., alarm, trouble).

F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

G. General: Components include battery, charger, and an automatic transfer switch.

H. Battery: (SIMPLEX 2081-9276) Sealed lead-acid. Provide sufficient
capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.

2.04 ADDRESSABLE MANUAL PULL STATIONS (SIMPLEX 4099-9001)

A. Description: Addressable single-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

B. Protective Shield: Where required provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

2.05 SMOKE SENSORS

A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems.” Include the following features:

1. Factory Nameplate: Serial number and type identification.
2. Operating Voltage: 24 VDC, nominal.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
4. Each sensor base (SIMPLEX 4098-9792) shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
5. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
6. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a “wrong device”, the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
7. The sensor’s electronics shall be immune from false alarms caused by EMI and RFI.
8. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
9. Removal of the sensor head for cleaning shall not require the setting of addresses.
B. Type: Smoke sensors shall be of the photoelectric (SIMPLEX 4098-9792) or combination photoelectric / heat type (SIMPLEX 4098-9602). Where acceptable per manufacturer specifications, ionization type sensors may be used.

C. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.

D. Duct Smoke Sensor: (SIMPLEX 4098-9756) Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.
   1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
   2. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
   3. Duct Housing shall provide a relay control trouble indicator Yellow LED.
   4. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
   5. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
   6. Duct Housing shall provide a magnetic test area and Red sensor status LED.
   7. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
   8. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.
   9. Where indicated a NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.]

2.06 HEAT SENSORS (SIMPLEX 4098-9733)

A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.

B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
C. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.

D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

2.07 ADDRESSABLE CIRCUIT INTERFACE MODULES (SIMPLEX 4090-9001)

A. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.

B. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.08 MAGNETIC DOOR HOLDERS (SIMPLEX 2088-9608)

A. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develops a minimum of 25 lbs. holding force.

B. Material and Finish: Match door hardware.

2.09 STANDARD ALARM NOTIFICATION APPLIANCES

A. VISIBLE ONLY: (SIMPLEX 4906-9101) Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflect system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with selectable flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.

B. SPEAKER/VISIBLE: (SIMPLEX 4906-9151) Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480.
1. Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC using and UTP conductors,
having a minimum of 3 twists per foot is required for addressable strobe connections.

2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

3. The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.

4. The S/V installs directly to a 4” square, 1 1/2 in. deep electrical box with 1 1/2” extension

C. Accessories: The contractor shall furnish the necessary accessories.

PART 3  EXECUTION

3.01 INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
   1. Factory trained and certified personnel.
   2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
   3. Personnel licensed or certified by state or local authority.

3.02 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.

B. All fire alarm panels shall be monitored and networked via the existing campus fiber optic network.

C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material. Remove all associated conduit and wiring. Provide blank cover plate over all abandoned outlets recessed in walls.

D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.
3.03 WIRING INSTALLATION

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AHJ) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

3.04 FIELD QUALITY CONTROL

A. Manufacturer’s Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
   1. Factory trained and certified.
   2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
   3. International Municipal Signal Association (IMSA) fire alarm certified.
   4. Certified by a state or local authority.
   5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

E. Minimum System Tests: Test the system according to the procedures...
outlined in NFPA 72.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.

H. Final Test, Certificate of Completion, and Certificate of Occupancy:
   1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.

3.05 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.06 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
   1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
   2. Schedule training with the Owner at least seven days in advance.

END OF SECTION
SECTION 31 00 00
SITE PREPARATION

PART 1     GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment and services for all site clearing, tree protection, stripping topsoil and demolition as indicated, in accord with provisions of Contract Documents.

2. Completely coordinate with work of all other trades.

3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.02 QUALITY ASSURANCE

A. Perform work in accord with OSHA and EPA requirements and state and local requirements.

1.03 SUBMITTALS (See Section 01 33 23)

A. Shop Drawings: Not required.

B. Product Data: Not required.

C. Samples: Not required.

D. Project Information: Not required.

PART 2     PRODUCTS - NOT USED

PART 3     EXECUTION

3.01 PROTECTION

A. Provide barricades, coverings, and other protection necessary to prevent damage to existing improvements to remain:

1. Protect improvements on adjoining properties as well as those on Owner’s property.

2. Restore any improvements damaged by this work to original condition, as acceptable to Owner or other parties or authorities having jurisdiction.
B. Protect existing trees and other vegetation to remain against damage:

1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
2. Avoid foot or vehicular traffic or parking of vehicles with drip line.
3. Provide temporary protection as required. This includes temporary fencing, barricades, warning tape or other materials or means which are needed to protect the public and the contractor's forces.

3.02 IMPROVEMENTS ON ADJOINING PROPERTY

A. None Required.

3.03 TOPSOIL SALVAGE

A. Definitions:

1. Topsoil: Fritable clay loam surface soil found in depth of not less than 4 IN (100 mm).
2. Satisfactory Topsoil: Reasonably free of subsoil, objects over 2 IN (50 mm) in diameter, weeds, and roots.

B. Strip topsoil to whatever depths encountered, in manner to prevent intermingling with underlying subsoil or objectionable material.

1. Where trees are indicated to be left standing, stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.

C. Stockpile Topsoil where Directed:

1. Construct storage piles to freely drain surface water.
2. Seed or cover storage piles to prevent erosion.

D. Strip topsoil in all areas where changes of grade occur.

3.04 REMOVAL OF IMPROVEMENTS

A. Remove surfacing and pavements, including bases, concrete slabs, concrete curb and gutter, valve boxes, concrete walls, posts, poles, fences, manhole frames and covers, and other items indicated.

3.05 DISPOSAL OF WASTE MATERIALS

A. Do not burn combustible materials on site.
B. Remove all waste materials from site.
C. Do not bury organic matter on site.
D. Remove all rock, concrete, asphalt, and masonry from site.

3.06 DISPOSAL OF EXCESS TOPSOIL
A. Excess topsoil, not required for re-use on lawns, landscaped and seeded areas may be removed from the site.

3.07 REMOVAL OF DEBRIS
A. Remove all debris from the site and dispose of all removed material legally off site. Leave the site in a neat and orderly condition to the approval of the Designer. Debris receipts will be required to be turned over to the Owner.

3.08 SAFETY
A. The Contractor is to observe all Safety Laws of Local, State and Federal Government in executing this work. This specifically includes all O.S.H.A. Requirements.
B. Provide all warning signs, barricades, lights and other necessary safety devices required by Agencies mentioned in Paragraph 3.08.A.
C. Protect the occupants of the facility, the general public, and workers at all times.

3.09 CLEAN UP
A. The Contractor is to keep his operations clean at all times during execution of demolition work.
B. Streets, highways, roads, existing paved areas and sidewalks shall be cleaned of all mud, dirt, and debris daily and kept clean during construction of this project.

END OF SECTION
SECTION 31 20 00

EARTHWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough grading and finish grading, including compaction of fill, shall be performed as a part of this contract.

B. This contract shall include trenching for utilities and footings, backfilling and compaction of trenches, and providing subbase under slabs and paving.

C. Backfill and Fill: Use soil material free of clay, rock, or gravel larger than 2: in any direction, debris, vegetable matter, waste, and frozen materials, with plasticity index less than 30.

D. Slab On Grade Subbase: Use washed, uniformly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1-1/2" sieve and not more than 5% passing a No. 4 sieve.

E. Pavement Subbase: Use naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand, as acceptable to Designer.

F. Compaction: Provide not less than the maximum density (standard proctor) for soils compacted at optimum moisture content, for the actual density of each layer of soil material in place listed in the Soils Report recommendations in this manual.

G. Rock Excavation:

1. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:

a. 24 inches (600 mm) outside of concrete forms other than at footings.

b. 12 inches (300 mm) outside of concrete forms at footings.

c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.

d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.

e. 6 inches (150 mm) beneath bottom of concrete slabs on grade, 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.
H. Excavation and Dewatering: It is not anticipated that ground water will be encountered in the areas of deeper undercut however dewatering will be required in trenches from stormwater.

I. Classification and Excavation: Rock is defined as solid non-soil masses other than demolition items that cannot be removed with a track mounted excavator.

END OF SECTION
SECTION 31 22 00

EXCAVATION, BACKFILLING AND COMPACTION

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Excavation for building foundations.

B.  Excavation for slabs-on grade, paving and landscaping.

C.  Excavation for site structures.

D.  Excavation for Mechanical/Electrical Work: Excavation and backfill required in conjunction with underground mechanical and electrical utilities, and buried mechanical and electrical appurtenances.

E.  Backfilling of trenches.

F.  Building perimeter and site structure backfilling to subgrade elevations.

G.  Fill under paving.

H.  Fill over excavation.

I.  Consolidation and compaction.

J.  Filling where required to obtain finish grade or subgrade.

1.02  REFERENCE STANDARDS


1.03  QUALITY ASSURANCE

A.  Codes and Standards: Perform excavation work in compliance with contract documents and applicable requirements of governing authorities having jurisdiction.

1.04  JOB CONDITIONS

A.  Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for convenience of Contractor.
B. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

C. Verify that survey benchmark and intended elevations for the Work are as indicated.

D. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

E. 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.

F. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Designer and then only after acceptable temporary utility services have been provided.

1. Provide minimum of 48-hour notice to Designer and receive written notice to proceed before interrupting any utility.

1.05 USE OF EXPLOSIVES

A. Explosives may not be used.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. Fill soils shall have standard proctor (ASTM D-698) dry unit weight of greater than 90 pcf and a Plasticity Index (PI) of less than 35%. Geotechnical Engineer shall approve all fill material used on site.

B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1" sieve and not more than 5% passing a No. 4 sieve. Compacted crushed stone fill shall be Type A, Class A, and Grading E in accordance with section 903.05 of the Tennessee Department of Transportation Specifications.

C. Backfill and Fill Materials: Satisfactory soil materials of clay, rock or gravel not larger than 2" in any dimension, free of debris, waste, frozen materials, vegetable and other deleterious matter. Plasticity index of less than 36%.

2.02 COMMON FILL MATERIALS

A. Subsoil: Reused; or imported; excavated material free of gravel larger than 3 inch size, and debris. Plasticity index of 35% or less.
2.03 FILTER FABRIC

A. 'TYPAR' 3601 or as approved equal.
B. Biaxial Geogrid Reinforcement – Type 2, Terragrid BX 1200 or Approved Equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify with Designer/Solis Engineer that fill materials to be reused are acceptable.
B. Verify with Designer that foundation perimeter drainage installation (if any) has been inspected.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.
B. Generally, compact subgrade to density requirements for subsequent backfill materials.
C. A heavily loaded, single axle dump truck utilizing a crisscross pattern should be utilized in areas that will receive structural fill to determine if any soft areas exist or sever pumping of the in place soils occur.
D. Prior to placement of aggregate base course material at building slabs or paved areas, compact subsoil to no less than 98% percent of the standard proctor maximum dry density in accordance with ANSI/ASTM D698. All fill beneath pavements and grade slabs shall be compacted to 98% percent. Moisture content of fill soils shall be maintained within +2 and -2 percentage points of the optimum moisture content determined from the standard proctor compaction test.
E. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
F. Protect above and below grade utilities which are to remain.

3.03 EXCAVATION

A. Excavation is unclassified.
B. The bidder shall draw his own conclusions as to the conditions to be encountered.
C. Do not allow water to accumulate in excavations. Remove water to prevent softening of subgrade foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run off areas. Do not use trench excavations as temporary drainage ditches.

D. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 6" to 9" clearance on both sides of pipe or conduit.

E. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze ups.

Where rock is encountered, excavation shall be required to carry 1' - 0" below required elevation and backfill with a 6" layer of crushed stone or gravel prior to installation of pipe.

F. Temporary construction excavations should be sloped or shored in accordance with Local, State and Federal Regulations including OSHA (29 CFR Part 1926) excavation and trench safety.

3.04 BACKFILL AND FILL

A. General: Place acceptable soil material in layers to required subgrade elevations, for each area.

B. Building Slab Drainage Course:

1. General: Drainage course consist of placement of a minimum of 4" of stone: Comprised of 4" of compacted crushed run stone. Crusher run stone is to be placed directly under slab.

2. Placing: Place drainage fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross section and thickness. Maintain optimum moisture content for compacting material during placement operations.

3. When a compacted drainage course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 2" in thickness when compacted.

3.05 COMPACTION

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.
B. All compacted fill shall be constructed by spreading acceptable soil in loose layers not more than 8 inches thick. The soils used within proposed building and paved areas shall be compacted in lifts to at least 98 percent of the standard Proctor maximum dry density (ASTM D-698). At grade slabs, limit of compaction will extend 10' - 0" beyond edge of slab.

The moisture content of the fill soils shall be maintained within +2 and -2 percentage points of the optimum moisture content determined from the standard Proctor compaction test.

1. Lawn or Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material to at least 90% maximum density.

2. Walkways: Compact top 12" of subgrade and each layer of backfill or fill material to at least 98% maximum density.

3. Embankment Areas Around Buildings and Retaining Walls - 98%.

4. Paved Areas – 98% (in upper 2 feet from subgrade).

5. Paved Areas – 95% (below 2 feet from subgrade).

6. Trench Lines – per the above depending upon location/elevation.

C. Moisture Control: 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, to prevent free water appearing on surface during or subsequent to compaction operations.

D. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

E. Soil material that is to be removed under the building may be used if it meets the requirements of the specification for use under parking lots. It is anticipated that some soils required to be removed will not be suitable for re-use and will have to be discarded off site.

3.06 TOLERANCES

A. Top Surface of Backfilling: Under Paved Areas: Plus or minus one inch from required elevations.

B. Top Surface of General Backfilling: Plus or minus one inch from required elevations.

3.07 FIELD QUALITY CONTROL

A. Contractor will engage testing service for quality control testing and on site job observation during earthwork operations. Testing service is to be approved by the Designer prior to start of construction.
B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D698.

C. Compaction testing will be performed in accordance with ANSI/ASTM D698.

D. If tests indicate Work does not meet specified requirements, work will be required to be removed and reworked until work meets test requirements and the requirements of the contract documents.

E. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.

F. Footing Sub-Grade: For each strata of soil on which footings will be placed, allow tests to verify required design bearing capacity of 2000 lbs./s.f.

G. Paved Areas and Building Slab Sub-Grade: Allow tests to verify required design bearing capacities.

H. Foundation Wall Backfill: Allow for field density tests to verify design requirements.

3.08 PROTECTION

A. Protect excavations by methods required to prevent cave in or loose soil from falling into excavation.

B. Protect bottom of excavations and soil adjacent to and beneath foundation, from freezing.

C. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Provide temporary drainage swales or other structures to prevent ponding of water within construction limits.

D. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

E. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

F. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other construction), add backfill material, compact, and replace disturbed construction. Restore appearance, quality, and condition of surface, finish and construction to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
3.09 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner’s Property:

1. Remove trash, debris, roots, tree stumps, mass rock, and dispose of it off Owner’s property. Contractor is responsible for material that leaves the site.

2. Remove excess soils from site. Contractor will be responsible for leveling dumped material and to make an effort to minimize run off of dumped materials. Contractor is responsible for material that leaves the site and its proper disposal.

END OF SECTION
SECTION 31 22 10

GRADING

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Spread existing topsoil as required by these Specifications for proper growth of seeding, ground cover, and landscaping.

B.  Excavate topsoil at areas where new walks, buildings or other miscellaneous construction is to be installed.

C.  Finish grade where required.

D.  Place, level, and compact topsoil.

1.02  QUALITY ASSURANCE

A.  Codes and Standards: Perform grading in compliance with requirements of governing authorities having jurisdiction.

1.03  SAMPLES

A.  Submit samples under provisions of Section 01 33 23.

B.  Submit 10 lb. sample of imported fill to testing laboratory, in air-tight containers.

1.04  PROJECT RECORD DOCUMENTS

A.  Submit documents under provisions of Section 01 33 23.

B.  Accurately record location of utilities remaining, rerouted utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

A.  Protect trees, shrubs, lawn, and other features remaining as portion of final landscaping.

B.  Protect bench marks, existing structures, fences, roads, sidewalks and paving and curbs.

C.  Protect above or below grade utilities which are to remain.

D.  Items indicated to remain are to be repaired if damaged during construction. Restore to condition before construction.
PART 2  PRODUCTS

2.01  MATERIALS

A. Topsoil: Excavated material, graded free of roots, rocks larger than one inch subsoil, debris, and large weeds. If additional topsoil is required to complete work, Contractor shall furnish them offsite.

B. Subsoil: Excavated material, graded free of lumps larger than 6 inches; rocks larger than 3 inches and debris.

PART 3  EXECUTION

3.01  INSPECTION

A. Verify site conditions and note irregularities affecting work of this Section before beginning work.

B. Beginning work of this Section means acceptance of existing conditions.

3.02  PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Identify known below grade utilities. Stake and flag locations.

C. Identify and flag above grade utilities.

D. Maintain and protect existing utilities remaining which pass through work area.

E. Notify utility company to remove and relocate utilities.

F. Upon discovery of unknown utility or concealed conditions.

1. If active and damaged, immediately restore to working order, discontinue affected work, notify Designer.

2. Otherwise, discontinue affected work, notify Designer.

3.03  TOPSOIL

A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded and stockpile on site.

B. Excavate topsoil (1-1/2' depth) from new construction areas, parking areas, any area that will require structural fill or any area which will have concrete pads or structures placed in that area. There will not be any topsoil excavation required in the building area. See drawings for further description.

C. Do not excavate wet topsoil.
D. Cover or protect topsoil from erosion.

3.04 PLACING TOPSOIL

A. Place topsoil in areas where planting is scheduled and where indicated on drawings. The majority of the site has topsoil in place.

B. Use topsoil in relatively dry state. Place during dry weather.

C. Fine grade topsoil eliminating rough or low areas. Maintain levels, profiles, and contours of subgrade.

D. Remove stone, roots, grass, weeds, debris, and foreign material while spreading.

E. Manually spread topsoil around trees, plants and building to prevent damage.

F. Lightly compact placed topsoil.

G. Remove surplus subsoil and topsoil from site. Refer to Paragraph 3.09, Section 31.22.00, Excavation, Backfilling and Compaction.

H. Leave stockpile area and site clean and raked, ready to receive landscaping.

I. Schedule of Locations:

1. The following paragraphs identify compacted topsoil thicknesses for various locations.
2. Seeded Grass: 6" inches.
4. Shrub Beds: 18" inches.
5. Flower Beds: 12" inches.

3.05 TOLERANCES

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes, and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.
2. Walks: Shape surface of areas under walks to line, grade and cross section, with finish surface not more than 0.10' above or below required subgrade elevation.

3. Pavements: Shape surface of areas under pavement to line, grade and cross section, with finish surface not more than 1/2" above or below required subgrade elevation.

END OF SECTION
**SECTION 31 25 00**

**LANDSCAPE BOULDERS AND RIVER STONE**

**PART 1  GENERAL**

1.01 DESCRIPTION

A. Provide labor and materials to furnish and install boulders at project locations as shown on the drawings and specified herein.

B. Related Requirements Specified Elsewhere:
   1. General Requirements: Division 1 Sections.
   2. Earthwork: Section 31 20 00.

1.02 QUALITY ASSURANCE

A. Landscape boulders and river stone shall be of a natural shape and finish. The boulders and river stone shall be provided from sources approved by the Designer.

B. Provide one (1) sample of boulder work and river stone in respective areas of the project as directed by the Designer. Area of each sample shall be no smaller than 10’ by 10’. In the event sample is unacceptable prepare other sample(s) until accepted. Obtain Designer's approval in writing before beginning the work of this section.

C. Approval and Selection of Materials and Work:
   1. The selection of all materials and the execution of all operations required under the specifications and drawings is subject to the approval of the Designer. The Designer has the right to reject any and all materials and any and all work which, in the opinion of the Designer does not meet the requirements of the Contract Documents at any stage of the operations. The Contractor shall remove rejected work and or materials from job site and replace promptly.

1.03 SUBMITTALS

A. Submit to the Designer evidence of an understanding of the type of boulders required by submitting the following:
   1. Written notification stating source of satisfactory material.
   2. Photographs and/or video photography of each type of boulders proposed.
   3. Samples of river stone

B. Submit schedule showing scheduled dates for installation of boulders coordinated with adjacent construction.

C. Submit jobsite sample in accordance with requirements in 1.02 above.
1.04 DELIVERY AND HANDLING

A. Boulders and river stone shall be carefully handled and transported to the site and carefully placed to avoid scarring or damage to the rock material or surrounding surfaces and improvements. Scarred broken or damaged rock shall be unacceptable. Rock with exposed drill holes shall be unacceptable.

1.05 PROJECT CONDITIONS

A. Protect existing utilities, paving, structures, and other facilities from damage caused by boulder transportation and placement operations.

PART 2 PRODUCTS

2.01 LANDSCAPE BOULDERS

A. Landscape boulders shall be of rock materials indigenous to geographic area in which the project is located. Size of boulders shall not be less than specified below. Boulders larger than specified will be acceptable if they meet all other specified requirements. Color shall be gray.

B. Landscape boulders shall be provided in the approximate sizes (length, width and height) described below:

<table>
<thead>
<tr>
<th>Size</th>
<th>Boulder Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'x3'x2'</td>
<td>A</td>
</tr>
<tr>
<td>3'x5'x2'</td>
<td>B</td>
</tr>
<tr>
<td>5'x8'x3'</td>
<td>C</td>
</tr>
</tbody>
</table>

C. Rock material smaller than boulder size specified may be used as shim and blocking material.

2.02 RIVER STONE

A. River stone shall be of rock materials indigenous to geographic area in which the project is located.

B. River stones shall be rounded sandstone or quartzite which are generally the size shown on the drawings. Variation from the sizes shown on the drawings may be acceptable if the river stones meet all requirements and will accomplish the aesthetic intent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Place boulders in locations and in the manner shown on the drawings. Securely stack and bury boulders below finish grade to achieve a "stepped" surface where shown on the drawings and in accordance with approved samples.

B. Provide the necessary overlap of boulders in "stepped" arrangement to minimize void spaces between boulders.
C. Install rock material smaller than specified boulder size to shim and block boulders in a stable, locked position as required. No rock smaller than the minimum size specified shall be used to form the surface of any boulder field.

3.02 ACCEPTANCE

A. All finished landscape boulders shall be stable. No rock shall be capable of being displaced by the movement or effort of three adults.

B. Upon completion of boulder work obtain Designer's approval in writing for acceptance of boulder work. Where specified work does not comply with requirements and approved samples replace and/or adjust and re-position rejected work until re-inspected by Designer and found to be acceptable. Remove rejected materials promptly from project site.

3.03 CLEANING

A. All exposed surfaces of boulders shall be cleaned as necessary to remove dirt, stains, concrete, construction debris and all other deleterious material at completion of construction operations.

B. Care shall be taken that no part of the surrounding site work be damaged by the cleaning process.

END OF SECTION
SECTION 31 25 00
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1  GENERAL

1.01  DESCRIPTION

A. This section includes Temporary Erosion and Sediment Controls in accordance with the Tennessee General NPDES Permit (TNR10000) for storm water discharges associated with construction activity (TNCGP) as required by the State of Tennessee. Contractor is responsible for carrying out all construction activity in compliance with these requirements.

B. The construction activity will be carried out in such a manner as will prevent any discharge that would cause a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of the waters on the property or downstream of the property for fish and aquatic life, livestock watering and wildlife, recreation, irrigation, navigation, or industrial or domestic water supply.

1.02  REQUIREMENTS

A. Provide under this section all measures required by the Project Documents, Federal Clean Water Act of 1972 with 1977 Amendments and associated Tennessee State Regulations.

1.03  SPECIAL REQUIREMENTS

A. The Contractor shall identify the following to the Owner and Designer prior to commencement of soils disturbing activities.

1. Individual responsible for installation, maintenance and inspections of erosion and sediment control measures. Contractor’s assigned person shall have completed the Fundamentals of Erosion Prevention and Sediment Control course offered by the State of Tennessee.

2. Contact information for that individual including cell phone number.

3. Contractor shall be required to reimburse the Owner for any fines levied due to non-conformance or non-compliance with these requirements.

1.04  SEQUENCE OF MAJOR ACTIVITIES WHICH DISTURB SOILS

A. Safety fencing will be placed around the perimeter of the construction site.
B. Silt fencing is to be placed as shown on the Drawing L-113, detail of the fencing is shown on Drawing L-114. Silt fencing shall be installed at intervals shown in Table 1 Section “Silt Fence-SF” in the Tennessee Erosion and Sediment Control Handbook. Silt fencing and inlet protection on existing catch basins is to be installed prior to start of earth moving operations. All erosion prevention and sediment control best management practices in this project will be installed as recommended in the Tennessee Erosion and Sediment Control Handbook.

C. Sediment will be removed from sediment traps, silt fences and other sediment controls before the design capacity of the structure has been reduced by 50%. Liter, construction debris and construction chemicals exposed to storm water will be picked up prior to anticipated storm events and at the end of this area of construction. After use, silt fences will be removed or otherwise prevented from becoming a pollutant source from storm water discharges. Temporary measures may be removed at the beginning of the work day but will be replaced at the end of the work day.

D. Stabilization will be accomplished as soon as practicable after attainment of final grade and no later than seven days after attaining final grade. Where earth disturbing activity has temporarily ceased, temporary stabilization will be applied within seven days if the activity will not resume within 15 days. The dates when major grading activities temporarily cease on a portion of the site and the dates when stabilization measures are initiated will be recorded and maintained on the site by the General Contractor.

Stabilization methods are outlined in the stabilization plan and may include seed and mulch or seed and sod and erosion control blankets. Roads shall be stabilized using coarse aggregate as soon as final road grade is obtained. Note that unpacked gravel containing fines or crusher run will not be considered an acceptable stabilization practice.

E. After all earth moving activities are completed and stabilization is installed including replacement of existing concrete and the establishment of growth on seeded areas, the silt fencing and basin inlet protection will be removed.

1.05 ALTERATION OF WATERS

A. No discharges associated with industrial activities other than construction storm water is anticipated.

B. No alterations of waters anticipated.

C. Any deviation from this section must be reported, approved and permitted as required prior to commencement of construction activities.
1.06 ON SITE MATERIAL STORAGE

A. Each General Contractor and Sub-Contractor is responsible to provide litter control for trash generated by his crew. A dumpster for garbage will be located near the construction trailer and is limited to garbage and paper trash only. Paint cans, oil cans, used oil, and filters will be contained and disposed of by the General Contractor by taking them to the Washington County Hazardous Waste Disposal Center.

B. No solid materials, including building materials, shall be discharged to waters of the United States, except as authorized by a Section 404 Permit and/or Tennessee Aquatic Resource Alteration Permit.

C. Off site vehicle tracking of sediments and the generation of dust shall be minimized.

D. Concrete trucks will not be allowed to wash out on site. Wash out can only be done at the NPDES Regulated Ready Mixed Concrete Facility.

E. Controls shall be implemented to reduce pollutants from material stored on site. Controls to include water proof covering of stockpiled materials including soil, sand, etc. to prevent runoff, placing in all stored material including all steel items, bulk wiring, etc. on cribbing or pallets with a water proof covering and ventilation to prevent condensation. See specifications and manufacturers recommendations for additional storage requirements.

1.07 ADDITIONAL REQUIREMENTS

A. Interim and permanent stabilization practices includes the use of temporary seed, permanent seeding and erosion control seeding mats. Pre-construction vegetative ground cover shall not be destroyed, removed or disturbed more than 10 calendar days prior to grading or earth moving unless the area is seeded and/or mulched or other temporary cover is installed. Stabilization will be accomplished as soon as practicable after attainment of final grade and no later than seven days after attaining final grade.

B. If sediment escapes the construction site, off site accumulations of sediment that have not reached a stream must be removed at frequency sufficient to minimize offsite impacts e.g., fugitive sediment that has escaped the construction site and has collected in street must be removed so that it is not subsequently washed into storm sewers and streams by the next rain and/or so that it does not pose a safety hazard to users of public streets. Primary Contractor shall not initiate remediation/restoration of a stream without consulting the TDEC Division first.

C. Litter, construction debris, and construction chemicals exposed to storm water shall be picked up prior to anticipated storm events (e.g. forecasted by local weather reports), or otherwise prevented from becoming a pollutant source for storm water discharges (e.g. screening outfalls, daily pick up, etc.).
D. Pre-construction vegetative ground cover shall not be destroyed, removed or disturbed more than 10 calendar days prior to grading or earth moving unless the area is seeded and/or mulched or other temporary cover is installed.

1.08 IMPAIRED OR HIGH QUALITY WATERS PROVISIONS

A. If the controls are installed and maintained correctly but are found to provide an inadequate level of protection, Beeson, Lusk & Street, Inc., will make revisions to this plan and these revisions will be implemented by the General Contractor.

B. Based on the results of the inspection, any inadequate control measures or control measure in disrepair shall be replaced or modified, or repaired as necessary, by the Contractor before the next rain event, if possible, but in no case more than 7 days after the need is identified.

1.09 SPILLS AND NON-STORM WATER CONTINGENCIES

A. All fueling of equipment and vehicles on site will be conducted near the construction entrance/staging area. Any spillage will be removed immediately. Contaminated soils will be placed on heavy plastic and covered or placed into approved containers to prevent contact with storm water. All fuel tanks will be in the containment area. Oils, other vehicle fluids, paints, and solvents will be stored in the construction trailer. Any spill in excess of two gallons will be reported to the representative of the General Contractor.

B. If a release containing a hazardous substance in an amount equal to or in excess of a reporting quantity established under either 40 CFR 117 or 40 CFR 302 occurs during a 24 hour period, the General Contractor will immediately notify the permittee who shall then do the following: Notify the National Response Center (NRC) (1-800-424-8802) and the Tennessee Emergency Management Agency (TEMA) (Emergencies: 1-800-262-3300; Non-Emergency: 1-800-262-3400); as well as the Local Environmental Assistance Center. Also, Beeson, Lusk & Street, Inc., will prepare a revision of this document to identify measures to prevent the re-occurrence of such releases.

PART 2 PRODUCTS

2.01 PERMANENT AND TEMPORARY SEEDING MIXTURES

A. Utilize the following mixtures where mixtures are not specified in other areas of these specifications. See Specification Section 32 92 19 Sodding, Seeding and Groundcover.
2.02 EROSION CONTROL BLANKETS

A. The erosion control blanket shall consist of a 100% biodegradable rolled erosion control product manufactured from long lasting natural fibers mechanically attached to or woven into low continuous 100% biodegradable netting structures. The erosion control blanket in an unvegetated state must be capable of reducing soil loss to under 0.25 inch (0.64 cm) at the bottom 10% of a 1:1, 50' feet (15.2 m) slope consisting of Loam soil for a minimum time period of 12 months. The erosion control blanket shall be North American Green C125BN or approved equal. Product performance documentation using soil loss calculations based on the USDA RUSLE method must be submitted for review. Product must be guaranteed to perform to the minimum performance standards under the specific conditions as stated above.

1. Matting:
      1. Matrix: 100% coconut fiber, minimum weight 0.50 lbs./yd2 (0.27 kg/m2).
      2. Netting: Top and bottom, woven natural fiber with 0.50-1.00 inch (1.27-2.54 cm) openings.
      3. Stitching: Biodegradable thread on 1.50 inch (3.81 cm) centers.
      4. Roll Size: 6.67 feet (2.03 m) x 108.00 feet (32.92m), 80.00 yd2 (66.89 m2).
      5. Roll Weight: ± 10%: 52.22 lbs. (23.69 kg).

2. Staples:
   a. The erosion control material(s) shall be anchored with "U" shaped 11 gauge wire staples or wooden staked with a minimum top width of 1" inch (2.5 cm) and length of 6" inch (15.2 cm). Installed per manufacturer's recommendations.

PART 3 EXECUTION

Not Used.

END OF SECTION
PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SCOPE

A. This work shall consist of minipiles and caps, designed, furnished, installed and tested in accordance with these specifications and as shown on the contract drawings.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design the minipile foundation system.

B. The design professional selected by the contractor shall be approved by the Architect and Structural Engineer of Record. The design professional shall select the minipile type and the installation method, and determine the length and diameter. The contractor shall be responsible for installing in accordance with the testing subsection of this specification. Contractor’s proposal for said work shall explain in detail the materials, methods, and design assumptions to be employed.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. The contractor’s design professional engineer shall prepare and submit to the engineer of record for review and approval, working drawings and design submission describing the pile system or systems intended for use including but not limited to piles, pile caps, and pile cap tie beams. All drawings and calculations shall be prepared under the supervision of a registered professional engineer registered in the state of Tennessee and familiar with auger micropile design and bear his seal. The working drawings and design submission shall be submitted 30 calendar days prior to the commencement of the minipile work. The working drawing and design submission shall include the following:
   1. A drawing showing the location and orientation of each minipile.
   2. A minipile schedule giving:
      a. Minipile number;
      b. Minipile design load; and
      c. Type and size of minipile.

C. The contractor shall submit to the engineer, for review and approval or rejection, mill certification for the steel piling components.
D. The contractor shall submit to the engineer, for review and approval or rejection, calibration data for each test jack, pressure gauge and master pressure gauge to be used. The calibration tests shall have been performed by an independent testing laboratory and tests shall have been performed within 60 calendar days of the date submitted.

E. The engineer shall approve or reject the calibration data within five working days after receipt of the data. Testing cannot commence until the engineer has approved the jack, pressure gauge and master pressure gauge calibration.

F. The contractor shall submit to the engineer within 30 calendar days after completion of the minipile work a report containing:
   1. As-built drawings showing the location of the minipiles and pile lengths.
   2. Steel manufacturer’s mill test reports for the steel pile components incorporated in the installation.
   3. Detailed drilling records including depth to rock quality.
   4. Grouting records indicating the cement type and quantity injected.
   5. Minipile test results and graphs.

1.05 QUALIFICATIONS

A. The contractor performing the work described in the specification shall have installed minipiles for a minimum of five years. At the time of bid, the contractor shall submit a list containing at least five projects on which the contractor has installed minipiles. A brief description of each project and a reference shall be included for each project listed. As a minimum, the reference shall include an individual’s name and current phone number.

B. The contractor shall assign an engineer registered in Tennessee to supervise the work, with at least three years of experience in the design and construction of minipiles. The use of consultants or manufacturers’ representatives does not satisfy the requirements of this section. Drill operators and on-site supervisors shall have a minimum of one year experience installing minipiles with the contractor’s organization.

C. Work shall not be started on any piling nor materials ordered until approval of the contractor’s qualification are given. The engineer may suspend the minipile work if the contractor substitutes unqualified personnel for approved personnel during construction. If work is suspended due to the substitution of unqualified personnel, the contractor shall be liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of work will be allowed.

D. All work covered by these specifications shall be diligently performed and the scheduled completion dates shall be met or bettered by the contractor.

E. Contractor shall submit with the bid, a detailed manpower and equipment usage schedule showing buildup requirements for maintaining schedule. After review by owner, the contractor shall comply with the schedule and execution of the work. In the event, for various reasons, the contractor fails to meet the detailed schedule, the owner has the right to require the contractor to resort to other means to return the work to the previously agreed schedule.
F. Contractor shall submit a detailed narrative within his proposal describing the construction method to be employed, and encompassing all aspects, peripheral or otherwise, of the contractor’s site operation.

G. The owner and/or architect reserves the right to reject any or all bids on the basis of price or in the belief that the narrative content does not reveal that the contractor has given due thought to the construction process.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for seismic requirements for piling.

1.07 PRE-INSTALLATION MEETING

A. Convene one week prior to commencing work of this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement shall be Type I, II, or III conforming to ACI 150 shall be used for grout. In some applications where voids exist, sand may be added to the grout.

B. Admixtures which control bleed, improve flowability, reduce water content and retard set may be used in the grout, subject to the approval of the engineer. Admixtures, if used, shall be compatible with the manufacturer’s recommendation.

C. Water for mixing grout shall be potable.

D. Certification will be required for the steel components used in the piling.

PART 3 EXECUTION

3.01 INSTALLATION

A. Drilling: Unless otherwise directed, core drilling, rotary drilling, percussion drilling, auger drilling, driven casing or other acceptable means can be used. The minipile can be installed in the drill hole after drilling or it can be advanced by the drill.

B. Grouting: The contractor shall use a neat cement grout or a sand-cement grout with a minimum 28-day unconfined compressive strength of 5,000 psi. The cement shall not contain lumps or other indications of hydration. Admixtures, if used, shall be mixed in accordance with the manufacturer’s recommendation.

C. The grouting equipment shall produce a grout free of lumps and undispersed cement. The pump shall be equipped with a pressure gauge to monitor grout pressures. The pressure gauge shall be capable of measuring pressure of at least 150 psi or twice the actual grout pressures used by the contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer should be capable of continuously agitating the grout.

D. The grout shall be injected from the lowest point of the drill hole. The grout may be pumped through grout tubes, casing, hollow-stem-augers or drill rods. The quantity of
the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive heave in cohesive soils or fracturing of rock formations. The entire minipile shall be filled with grout.

E. Upon completion of grouting, the grout tube may remain in the hole but it shall be filled with grout.

F. After grouting, the minipile shall not be loaded for a minimum of three days.

3.02 TESTING

A. A minimum of one test pile shall be loaded to twice the design load. The load test shall be evaluated by the contractor and engineer to assure compliance with job performance requirements.

B. In lieu of reaction piles, two or more anchors may be installed to provide the reaction load. A structural beam certified for the load shall be set and attached to the anchors to complete the reaction assembly.

C. The load shall be applied with a calibrated hydraulic jack. A leveling plate shall be attached to the surface of the test pile and the jack shall be set in position, with the load centered on the pile.

D. The tests shall be performed in accordance with ASTM D 1143-81, Testing of Piles under Axial Compressive Load.

E. The test pile may be a production pile.

F. Contractor guarantees that should the test pile fail to give acceptable results, he will modify his design and install and test another pile at his expense.

3.03 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Section 01 40 00.

3.04 UNACCEPTABLE PILES

A. Unacceptable Piles: Piles that fail tests, are placed out of position, are below cut-off elevations, or are damaged.

B. Provide additional piles or replace piles to conform to specified requirements.
PART 1  GENERAL

1.01  SUMMARY

A. This Section includes exterior cement concrete pavement for the following:
   1. Walkways.

B. Related Sections include the following:
   1. Division 31 Section "Earthwork" for sub-grade preparation, grading, and
      subbase course.
   2. Division 32 Section "Pavement Joint Sealants" for joint sealants of joints
      in concrete pavement and at isolation joints of concrete pavement with
      adjacent construction.
   3. Division 3 Section "Cast-in-Place Concrete" for general building
      applications of concrete.

1.02  DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or
   more of blended hydraulic cement, fly ash and other pozzolans, and ground
   granulated blast-furnace slag.

1.03  SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete pavement mixture. Include alternate
   mixture designs when characteristics of materials, Project conditions, weather,
   test results, or other circumstances warrant adjustments.

C. Qualification Data: For manufacturer.

D. Material Test Reports: From a qualified testing agency indicating and
   interpreting test results for compliance of the following with requirements
   indicated, based on comprehensive testing of current materials:
   1. Aggregates. Include service record data indicating absence of deleterious
      expansion of concrete due to alkali-aggregate reactivity.

E. Material Certificates: Signed by manufacturers certifying that each of the
   following materials complies with requirements:
   2. Cementitious materials.
   3. Steel reinforcement and reinforcement accessories.
   4. Admixtures.
   5. Curing compounds.
   7. Bonding agent or epoxy adhesive.
   8. Joint fillers.
1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who 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."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.


E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Mockups: Cast mockups of full-size sections of each concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
   1. Build mockups 10' x 20' minimum size of each type of concrete paving in the location 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.
   4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
   5. Demolish and remove approved mockups from the site when directed by Architect.
   6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
   7. In the event samples are rejected, the Contractor shall prepare samples until accepted by the Landscape Architect.

G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
   1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials.
and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete producer.
d. Concrete pavement subcontractor.

1.05 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.02 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves with a radius 100 feet (30.5 m) or less.

B. 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.

2.03 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.

C. Plain Steel Wire: ASTM A 82, as drawn.

D. Deformed-Steel Wire: ASTM A 496.

E. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSl's "Manual of
Standard Practice” from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.04 CONCRETE MATERIALS

A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:


B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm)] nominal.

C. Fine Aggregate: Clean manufactured or natural sand as available locally, free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M.


F. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.05 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

1. Available Products:
   a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
   b. Burke by Edoko; Aqua Resin Cure.
   c. ChemMasters; Safe-Cure Clear.
   d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
   e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
   f. Euclid Chemical Company (The); Kurez DR VOX.
   g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; Aqua Kure-Clear.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
l. Symons Corporation; Resi-Chem Clear.
m. Tamms Industries Inc.; Horncure WB 30.
n. Unitex; Hydro Cure 309.
o. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2.06 RELATED MATERIALS


B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.07 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

C. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

D. Add air-entraining admixture at manufacturer’s prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-1/2-inch (38-mm) nominal maximum aggregate size.
2. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inch (25-mm) nominal maximum aggregate size.
3. Air Content: 5 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size

E. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing 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.

G. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:
   1. Fly Ash or Pozzolan: 25 percent.
   2. Ground Granulated Blast-Furnace Slag: 50 percent.

2.08 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
   1. When air temperature is between 85 deg F 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

3.01 EXAMINATION

A. Examine exposed sub-grades and sub-base surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared sub-base surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
   1. Completely proof-roll sub-base in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.

C. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
   1. Sub-base with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earthwork."

D. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and sub-grade is ready to receive pavement.

3.02 PREPARATION

A. Remove loose material from compacted sub-base surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.05 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.

C. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

D. Keyed Joints: Provide preformed key way-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate one-half of dowel length to prevent concrete bonding to one side of joint.

F. Isolation/Expansion Joints: Form isolation/expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet maximum, unless otherwise indicated.

2. Extend joint fillers full width and depth of joint.

3. Do not continue steel reinforcement across expansion joints
4. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
5. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
6. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
7. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

G. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows to match jointing of existing adjacent concrete pavement:

H. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a radius noted on the drawings. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

I. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate one-half of dowel length to prevent concrete bonding to one side of joint.

J. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete form work installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from sub-base surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten sub-base to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site.

F. Do not add water to fresh concrete after testing.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
   1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.

J. Screed pavement surfaces with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified on the plans for machine formed concrete. If results are not approved, remove and replace with formed concrete.

M. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

N. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

O. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and sub-grade just before placing concrete. Keep sub-grade moisture uniform without standing water, soft spots, or dry areas.

3.07 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
B. Comply with ACI 306.1 for cold-weather protection.
C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials: Water.
   a. Continuous water-fog spray.
   b. 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. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.08 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:
1. Elevation: 1/4 inch.
3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
7. Joint Spacing: 3 inches.
3.09 FINISHES ON FORMED CONCRETE SURFACES

A. Common finish shall be confined to concrete surfaces which will be covered by other construction and which will not be visible. This finish shall be produced by filling smoothly at tie holes, honeycomb and other depressions, knocking off and evening-up burrs and form marks.

B. A light sand blast finish will be applied to all exposed concrete surfaces. The contractor will produce a sample of the sand blast finish on an area of in-place concrete for approval by the designer prior to proceeding with the rest of the work.

C. A medium broom finish will be applied to all exposed concrete flatwork surfaces. The contractor will produce a sample of the medium broom finish on an area of in-place concrete for approval by the designer prior to proceeding with the rest of the work.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

C. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
   1. 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 mix. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

D. Concrete Temperature: ASTM C 1064; 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.

E. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

F. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
   1. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
G. Strength of each concrete mix will be satisfactory if average of any 3 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.

H. 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.

I. 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.

J. 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.

K. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

L. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

A. Remove and replace immediately, concrete pavement that is broken, damaged, or defective, does not comply with requirements in this Section and in the opinion of the designer does not reasonably match the approved mock up in color, texture, jointing or appearance.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur and protecting concrete pavement with plywood or other covering material.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION
SECTION 32 16 00
CONCRETE CURBS AND WALKS

PART 1   GENERAL

1.01   SECTION INCLUDES

   A. All sidewalks, steps, and ramps shall be 4000 psi cast in place concrete with 2" to 4" slump. Concrete shall be 5" thick. Entrained air to be 3% to 6%.

   B. Provide light broom finish with smooth troweled joints.

   C. Apply two coats of concrete sealer.

   D. Comply with Concrete and Reinforcement requirements.

   E. Provide construction joints every 4 – 6 feet on center or as shown on drawings. Provide expansion joints every 28 to 30 feet on center, maximum. Construct contraction joints to depth equal to at least 1/4 concrete thickness. Use premolded joint filler for expansion joints. See caulking section for non-tractions self-leveling joint caulking.

END OF SECTION
SECTION 32 31 20
CONSTRUCTION CHAIN LINK FENCING

PART 1 GENERAL

1.01 DESCRIPTION
A. Work Included: Chain link fencing required for this work is indicated on the drawings and includes, but is not necessarily limited to, fence and gates.

1.02 QUALITY ASSURANCE
A. For actual installation of chain link fencing and gates, use only personnel completely trained and experienced in installation of the approved materials and thoroughly familiar with the original design and the approved Shop Drawings.

1.03 SUBMITTAL
A. Within 35 days after award of Contract, and before any chain link fencing materials are delivered to the job site, submit Shop Drawings to the Architect in accordance with Section 01 33 23 of these Specifications.

1.04 PRODUCT HANDLING
A. Protection: Use all means necessary to protect chain link materials before, during, and after installation and to protect the installed work and materials of all other trades.
B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURER
A. Vinyl clad chain link fabric, framework, fittings and accessories shall be manufactured by Semmerling Fence & Supply, Inc. in the U.S.A.

Other approved manufacturers include the following:
1. Anchor Fence Inc.
2. Cyclone Fence Division
2.02 VINYL CLAD FENCE FABRIC

A. General: Fence systems shall have chain link fence fabric supplied with bonded vinyl clad coating over aluminized steel wire, manufactured in accordance with ASTM F668 class 2a or 2b respectively. The fence fabric shall be imprinted with the manufacturer’s trade name, country of origin (USA), ASTM specification (F668), core wire gauge, and finished outside diameter gauge.

B. Steel Core Wire Type: Steel core wire shall have an aluminum coating with a minimum coating weight of 0.20 oz. per square foot.

1. Vinyl Clad Coating: The chain link fence fabric shall have an extruded/bonded vinyl clad costing.
2. Wire Size: Steel core wire size is 9 gauge and the coated wire size is 8 gauge on this project.
3. Height and Mesh Size: Fabric height is 4’ or 16’ feet high with a mesh size of 2 inches.
5. Color: Color of vinyl coating shall be as chosen from full range of manufactured standard colors.

2.03 STEEL FRAMEWORK

A. General: Fence system shall have fence posts and rails vinyl coated, manufactured in accordance with Federal Specification RR-F-191/3D, Class 1, Grade A or B. Fence systems are to be supplied with vinyl coated fence posts and rails. The frame work for fence systems shall have a 10 to 14 mil coating.

1. Line Posts: Steel pipe shall be 2.375 inches O.D. weighing 3.117 lbs. per lineal ft.
2. End Posts and Corner Posts: Steel pipe shall be 3" inches O.D. weighing 4.640 lbs. per lineal ft.
3. Pull Posts: Stretches of fence more than 500 feet in length shall have one intermediate pull post with braces in both directions. Size and weight of pull post shall be the same as specified for end and corner posts.
4. Gate Posts: Furnish posts to support single gate leaf, or one leaf of a double gate, for the following gate widths:

<table>
<thead>
<tr>
<th>Leaf Width</th>
<th>Gate Post</th>
<th>Weight/Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 6’</td>
<td>3” O.D.</td>
<td>4.64 lbs.</td>
</tr>
<tr>
<td>6’ to 13’</td>
<td>4” O.D.</td>
<td>6.56 lbs.</td>
</tr>
<tr>
<td>13’ to 18’</td>
<td>6-5/8” O.D.</td>
<td>18.97 lbs.</td>
</tr>
<tr>
<td>18’ to 32’</td>
<td>8-5/8” O.D.</td>
<td>28.55 lbs.</td>
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5. Top Rail: The top rail shall be supplied in a maximum of 21' lengths joined by 6" long sleeves, and run continuously along the top of the fence through openings provided in the line post tops. The fence fabric shall be fastened to the top rail at intervals of 24" O.C. with fabric ties. Provide means for attaching top rail securely to each gate, corner, end and pull post. Steel pipe shall be 1-5/8" inches O.D. weighing 1.836 lbs. per linear foot.

6. Brace Rail: Brace rail shall be same size and weight specified for the top rail. Provide means of attaching brace rail securely to each gate, corner, end and pull post. Also use the same attaching method on adjacent line post.

7. Top Tension Wire or bottom Tension Wire: Aluminized steel core wire or galvanized steel core wire size shall be 9 gauge core 6 gauge O.D. on this project. The fence fabric shall be fastened to the tension wire at intervals of 24" O.C. with hog rings. Provide means of attaching tension wire securely to all terminal posts. Color to match fabric and manufacturing coating process.

2.04 FITTINGS AND ACCESSORIES

A. General: All fittings and accessories shall be vinyl coated and manufactured in accordance with Federal Specification RR-F191/4D. Color to match fence fabric.

1. Terminal Post Caps: Aluminum.

2. Line Post Cap: Aluminum.

3. Tension Bars: For 2" and 1-3/4" mesh use 3/16" X 3/4" steel. Bars shall be one-piece lengths up to 12', less 1'. Provide one tension bar for each gate and end post, and two for each corner and pull post.

4. Tension Bands: Fabricated from 12 gauge pressed steel. Spaced not over 14" O.C. to secure tension bars to terminal posts. Bands shall have beveled edges.

5. Brace Bands: Fabricated from 12 gauge pressed steel. Bands are to secure rail ends and truss rods to terminal posts. Bands shall have plain edges.

6. Truss Rods: Truss rods shall be 3/8" minimum diameter steel with adjustable takeups.

7. Fabric Ties: PVC coated 9 gauge (0.148") O.D. aluminum core wire.

2.05 GATES

A. General: Fence systems shall have gate frames coated, manufactured in accordance with Federal Specifications RR-F-191 and shall be vinyl coated.

1. Fence system shall be supplied Grade B pipe. Size and weight of used for gate frame shall have requirements of RR-F-191/2D or 1.90 O.D.

2. Assemble gate frames by using specially designed corner fittings or weld to form a rigid panel. If welded, all welded surfaces shall be coated with epoxy paint, color to match PVC coating on pipe. Frames shall be fitted with the same gauge fabric as the fence. The vertical sides shall be attached by use of tension bands and bars. The horizontal sides shall be attached by use of 9 gauge O.D. tie wires spaced 12" O.C.

B. Hinges:

1. Fence system shall be supplied with size and material to suit gate size, offset to permit 180 degree gate opening. Provide 1 pair of hinges for each leaf and 1-1/2 pair for each leaf and truss rod supports for extra large gates.

C. Latch: Fork latch for single swing gates and plunger-bar type for double swing gates, both to permit operation from either side of gate, with padlock eye as integral part of latch.

D. Drop Rod: To be provided for double swing gates.

E. Keeper: Provide keeper for double swing gates, in order to automatically engage gate leaf and hold it in open position until manually released.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that chain link fencing and gates may be installed in strict accordance with the original design and the approved shop drawings.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION

A. Install fence in accordance with ASTM Practice F567.

B. Handle all vinyl coated material with care. If vinyl finish is damaged during installation, contractor shall repair or replace material at no cost to the Owner.

END OF SECTION
SECTION 32 31 21
ALUMINUM LOUVER FENCING

PART 1  GENERAL

1.01  SUMMARY

A. Section includes: Ornamental fixed louver modular fencing panels fabricated with extruded aluminum louvers and flat aluminum bars including extruded aluminum fence posts and aluminum louver gates.

B. Related sections:
   1. Section 03 30 00 - Cast-in-Place Concrete: Concrete footings for support of fence posts.

1.02  REFERENCES

A. American Society for Testing and Materials (ASTM) Publications:
   1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
   2. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
   6. ASTM D3363 - Test Method for Film Hardness by Pencil Test.

1.03  SUBMITTALS

A. Provide in accordance with Division 1 requirements and as described herein.
   1. Product data for components and accessories.
   2. Shop drawings showing layout, dimensions, spacing of components and anchorage and installation details sealed by registrant in the state in which the project is located.
   3. Sample: 18 by 24 inches minimum size sample of fence panel illustrating design, fabrication, workmanship, and selected color coating.
   4. Copy of warranty specified in Paragraph 1.4 for review by Architect.

1.04  WARRANTY

A. Provide in accordance with Section 01 77 70 - Closeout Procedures:
   1. 20 year warranty for factory finish against cracking, peeling, and blistering under normal use.
PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, the following product of the listed manufacturer is approved for use on this project:
   1. Ametco® Manufacturing Corporation, 4326 Hamann Parkway, P.O. Box 1210, Willoughby, Ohio 44096; 800-362-1360 is basis of design.

B. Subject to compliance with requirements, equivalent products of other manufacturers may be submitted for the Architect’s review and approval.

2.02 MATERIALS

A. Extruded aluminum: ASTM B221, Alloy 6063, Temper T-6.


2.03 FENCE SYSTEM

A. Aluminum Fence System
   1. Ornamental fencing system consisting of horizontal, fixed louver, modular fence panels fabricated with extruded aluminum framing bars and supported by extruded aluminum fence posts; Model: Phoenix Aluminum Fixed Louver Fencing as manufactured by Ametco® Manufacturing Corporation.

B. Fence panel:
   1. Fixed louver bars: Extruded aluminum tube, 1/2 inch x 4 inches wide, spaced at 3-13/16 inches for 100 percent visual screening.
   2. Cross bars: 1/2 by 1/8 inch flat bars welded perpendicular to back side of louver bars and spaced at 18 inches.
   3. Direct Visual Screening shall be 100%.
   4. Panel height: 84" inches unless otherwise shown on approved shop drawings.
   5. Panel width: Varies, see approved shop drawings.
   6. Provide additional support as determined by the manufacturer.

C. Posts: Extruded aluminum solid shapes.
   1. Size: 4 inch by 4 inch or as shown on the approved shop drawings.
   2. Length: As shown on the approved shop drawings.

2.04 GATES

A. Provide gates of type and size indicated on Drawings. Equip gates with manufacturer's standard hardware as required for complete functional operation.

B. Type: Hinged swinging double gates.

   1. Construction: Welded frame fabricated from extruded aluminum tubing as determined by the manufacturer with aluminum fixed louver panels to
match fencing material all as shown on the approved shop drawings.

2. Nominal leaf sizes: 72" wide by 84" high; 60" wide by 84" high; 36" wide by 84" high.

3. Hardware:
   a. Hinges: Size and type as determined by manufacturer. Provide 2 hinges for each leaf up to 6 feet high and 1 additional hinge for each additional 24 inches in height or fraction thereof.
   b. Latch: 3/4 inch diameter slide bolt to accommodate padlock.
   c. For double gates provide padlockable, 5/8 inch diameter center cane bolt assembly and strike.

2.05 ACCESSORIES

A. Fasteners: Stainless steel bolts of type, size, and spacing as recommended by fence manufacturer for specific condition.

2.06 FACTORY FINISH

A. Aluminum fence panels and posts shall receive polyester powder coating. Large gate panels shall be coated with 2-part polyurethane coating.

B. Polyester powder coating: Electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.
   1. Minimum hardness measured in accordance with ASTM D3363: 2H.
   2. Direct impact resistance tested in accordance with ASTM D2794. Withstand 160 inch-pounds.
   3. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than [3/16 inch] [5 mm] undercutting.
   4. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees.

C. Polyurethane coating: 1.0 mil dry film thickness of coating of test panel cured 30 minutes at 180 degree F and aged 14 days shall resist the following test conditions without failure:
   1. 5 percent salt spray for 500 hours.
   2. 100 percent relative humidity for 1000 hours.
   3. Water immersion for 100 hours.
   4. 20 double rubs with cloth saturated with either lacquer thinner, acetone, MEK, gasoline, xylene.
   5. Exposure to lubricating oils, hydraulic fluids, and cutting oils.
   6. 16 cycles of 24 hours at 100 percent humidity, 24 hours at 10 degrees F, and 24 hours at 77 degrees F.
   7. Hardness: H to 2H.
   8. Flexibility: [1/8 inch] [3 mm] conical mandrel.

D. Color: Selected by Architect from manufacturer's standard range.
PART 3  EXECUTION

3.01  PREPARATION

A. Prior to fabrication, field-verify required dimensions.

B. Cast concrete footings in accordance with Section 03 30 00 - Cast-in-Place Concrete as detailed on Drawings and approved shop drawings.
   1. Minimum footing diameter:
      a. Terminal and gate posts: 12 inches.
      b. Intermediate line posts: 10 inches.
   2. Allow 36 inches minimum embedment of posts.
   3. Allow 6 inches minimum concrete beneath post bottom.

3.02  INSTALLATION

A. Install fencing in accordance with manufacturer's installation instructions and approved shop drawings.

B. Install fence posts plumb and level by embedding post directly in concrete footing. Temporarily brace fence posts with 2 by 4 wood supports until concrete is set.

C. Do not install bent, bowed, or otherwise damaged panels. Remove damaged components from site and replace.

D. Secure fence panels with standard stainless steel bolts to fence posts after posts have been set in footings.

E. Gates:
   1. Install gates and adjust hardware for smooth operation.
   2. Provide concrete center foundation depth and drop rod retainers at center of double swinging gate openings.

F. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

END OF SECTION
SECTION 32 91 19

TOPSOILING AND FINISHED GRADING

PART 1  GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all topsoiling and finished grading, as indicated, in accord with provisions of Contract Documents.

2. Completely coordinate with work of all other trades.

3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

4. See Division 1 for General Requirements.

B. Related Work Specified Elsewhere:

1. Excavation, Backfilling & Compaction: Section 31 22 00
2. Grading: Section 31 22 10
3. Erosion & Sediment Control: Section 31 25 00

C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.02 QUALITY ASSURANCE

A. Finish Grading Tolerance: 0.1 FT (30 mm) plus/minus from required elevations.

1.03 SUBMITTALS (See Section 01 33 23)

A. Shop Drawings: Not required.

B. Product Data: Not required.

C. Samples: Not required.

D. Project Information: Not required.
PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: Original fertile, friable surface soil typical of the area, capable of supporting native plant growth, reasonable free of subsoil, clay, weeds, roots, and stones larger than 1 IN.

PART 3 EXECUTION

3.01 ROUGH GRADE REVIEW

A. Rough grading reviewed by Architect in Section 31 22 10, Grading.

3.02 PREPARATION

A. Correct, adjust and/or repair rough graded areas.

1. Cut off mounds and ridges.

2. Fill gullies and depressions.

3. Pre-form other necessary repairs.

4. Bring all sub-grades to specified contours, even and properly compacted.

B. Loosen surface to depth of 2 IN (50 mm), minimum.

C. Remove all stones and debris over 2 IN (50 mm) in any dimension.

3.03 PLACING TOPSOIL

A. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.

B. Spread topsoil to compacted depth of 6 IN (100 mm) for all disturbed earth areas, except areas covered by buildings, paving, walks, sediment basins, rip-rap and areas not disturbed.

C. Make finished surface free of stones, sticks, or other material 1 IN (25 mm) or more in any dimension.

D. Make finished surface smooth and true to required grades.

E. Restore areas occupied by stockpiles to condition of rest of finished work.
3.04  ACCEPTANCE

A. Upon completion of topsoiling, obtain Architect's acceptance of grade and surface.

B. Make test holes where directed, to verify proper placement and thickness of topsoil.

END OF SECTION
SECTION 32 92 19

SODDING, SEEDING AND GROUND COVER

PART 1  GENERAL

1.01  DESCRIPTION

A.  General:

1.  Furnish all labor, materials, tools, equipment, and services for all sodding, seeding and ground cover as indicated, in accord with provisions of Contract Documents.

2.  Completely coordinate with work of all other trades.

3.  Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a complete installation.

4.  See Division 1 for General Requirements.

5.  Related Work Described Elsewhere:

   a.  Grading:  Section 31 22 10
   b.  Erosion & Sediment Control:  Section 31 25 00
   c.  Topsoiling and Finish Grading:  Section 32 91 19

B.  Location of Work: Temporary erosion control by seeding on all areas indicated, which are not occupied by other planting or construction. Sod all areas noted on drawings. Ground cover on sloped embankments where noted on drawings.

1.02  SUBMITTALS (See Section 01 33 23)

A.  Shop Drawings: Not required.

B.  Product Data: Not required.

C.  Samples: Not required.

D.  Project Information:

   1.  Certificates for sod stating botanical and common names and percentages of each species percentage of purity. Certificate of quality.

   2.  Copies of invoices for all fertilizer used on project, showing grade furnished, to determine total quantity applied.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver fertilizer in original container, labeled with content analysis.

1.04 JOB CONDITIONS

A. Perform sodding during conditions conducive to successful results.

1. Provide proper and adequate protection.
2. Do not lay when temperature is below 32° degrees F. (0° degrees C).
3. Do not lay in frozen or dried out soil.
4. Do not place frozen or dried out sod.
5. Lay within 24 hours of stripping.

PART 2 PRODUCTS

2.01 MATERIALS

A. Establish a smooth, healthy, uniform close stand of sod.

B. Sod: Viable, dense, strongly rooted, not less than 2 years old.

1. 60 percent Kentucky Bluegrass, 30 percent Fescue and 10 percent of other grasses.

2. Free of weeds and undesirable native grasses.

3. Strips 12" to 18" inches (300 to 450 mm) wide.

4. Mow prior to stripping from field.

5. Cut sod 3/4" inches (18 mm) of soil is firmly attached to roots.

6. Not frozen or dormant.

C. Fertilizer: Commercial fertilizer of 5-10-5 analysis, meeting applicable requirements of State and Federal Law.

1. Do not use cyanamic compounds or hydrated lime.

D. Water for Planting Purposes: Supplied by Owner. Provide all equipment necessary to transport water from source to required locations. Do not waste water.
PART 3  EXECUTION

3.01  SOIL PREPARATION

A. Limit preparation to areas which will be planted soon after preparation.

B. Loosen surface to minimum depth of 4" inches (100 mm).

C. Remove stones and debris over 1" inch (25 mm) in any dimension.

D. Distribute fertilizer uniformly over areas to be sodded at rate of 30 lb./1,000 s.f. (0.14 kg/sm).
   1. Use suitable distributor.
   2. Incorporate fertilizer into soil to depth of at least 2" inches (50mm).

E. Clean surface of substances which will interfere with turf development or subsequent mowing operations.

F. Grade areas to smooth, even surface with loose, uniformly fine texture.
   1. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
   2. Fine grade just prior to planting.

G. Restore areas to specified condition if eroded or otherwise disturbed between fine grading and planting.

H. If fertilizer application rate is determined (by invoices submitted) to be less than that specified, apply additional fertilizer.

3.02  SODDING

A. Lay to form solid mass with tightly filled joints.
   1. Butt ends and edges; do not overlap.
   2. Stagger joints.
   3. Blend sod into seeded areas.

B. Tamp or roll lightly to ensure full contact with subgrade.

C. Work sifted soil into minor cracks, avoid smothering adjacent grass.

D. Peg sod on slopes to prevent slippage.
   1. Use sharpened 1 x 1 x 6 inches (25 x 25 x 150 mm) wooden pegs.
3.03 SEEDING (Temporary)

A. After all areas to be seeded are graded and topsoil has been placed, experienced men shall sow seed with adequate equipment at a time when little or no wind is blowing.

B. Seed with annual rye grass at the rate of 3-5 lbs. per 1,000 square feet.

C. Hydro-Seeding is an acceptable method of seeding areas:
   1. Prepare soil as for seeding.
   2. Apply a mixture of fiber, specified seed, 16-16-8 fertilizer 15 lbs./1,000 square feet, and water with an approved hydraulic sprayer.
   3. Keep mulch and seed out of ground cover areas and off walks and areas to be paved. Clean up these areas.

3.04 GROUND COVER (Crown Vetch)

A. Provide Crown Vetch ground cover where noted on drawings.

B. Apply at the rate of 3-5 lbs. per 1,000 square feet with companion seeds of annual rye 3-5 lbs. per 1,000 square feet and Kentucky 31 3-5 lbs. per 1,000 square feet.

C. Apply 12-24 fertilizer at 1,000 lbs. per acre.

3.05 MAINTENANCE

A. Maintain grassed area for 30 days after planting.
   1. Water, fertilize, weed, mow, trim, roll, regrade, replant as required.
   2. Establish a smooth, healthy, uniform, close stand, free of eroded or bare areas, weeds and surface irregularities.

B. Provide and maintain temporary piping, hoses and watering equipment as required to keep seeded areas uniformly moist for proper growth.
   1. Lay out temporary watering system and arrange watering schedule to avoid walking over muddy and newly sodded areas.
   2. Prevent puddling and water erosion and displacement of sod.

C. Mow seeded areas as soon as there is enough top growth to cut with mower set at recommended height for principal species planted.
   1. Repeat mowing as required to maintain height.
2. Do not delay mowing until grass blades bend over and become matted.

3. Do not mow when grass is wet.

4. Time initial and subsequent mowings as required to maintain height of 1-1/2" to 2" inches (37 to 50 mm).

5. Do not mow lower than 1-1/2" inch (37 mm).

D. Resod bare, dead or dying areas using same materials specified.

END OF SECTION
SECTION 33 05 00

COMMON WORK RESULTS FOR UTILITIES

PART 1  GENERAL

1.01  RELATED DOCUMENTS

A. General provisions of the Contract, General and Supplementary Conditions, and General Requirements, apply to this section.

1.02  DESCRIPTION OF WORK

A. Provide labor, materials, equipment, and services necessary to install sanitary sewer, underground cold water and appurtenances, and related items, including trenching and backfilling, required to complete the work indicated on drawings, outside of buildings.

B. All work specified in this section is from a point 5 feet outside the building walls.

1.03  PERMITS AND CODES

A. Work shall comply with all applicable codes and regulations.

1.04  SUBMITTALS

A. Furnish to Designer, affidavits from manufacturers of pipe, pipe coating, fittings, valves, and meters furnished and installed under this Section, certifying that such materials delivered to the project conform to requirements of this specification.

1.05  LOCAL STANDARDS

A. Contractor shall contact utility company prior to bidding to determine local standards regarding approved piping materials for the municipality involved.

B. Term, "local standards", as used herein, means the standards of design and construction of respective municipal (or county) department or utility company.

1.06  EXISTING UTILITIES

A. Maintain in operating condition all active utilities, encountered in utility installation. Repair to satisfaction of Owner surface or sub-surface utilities damaged during course of work, unless such utility is shown to be abandoned or removed.
PART 2  PRODUCTS

2.01  WATER DISTRIBUTION SYSTEM MATERIALS

A.  Pipe Materials - Domestic Water:

1. Cold water piping 4" and under shall be seamless copper tubing, type K, complying with ASTM B88. Fittings shall be wrought copper or cast bronze solder joint.

B.  Pipe Materials - Fire/Water Main:

1. Water pipe outside building larger than 4" shall be Ductile iron pipe, class 350, conforming to AWWA C151, and shall have 350 psi minimum pressure rating, push on joint type. All ductile iron pipe shall have AWWA Specification C104 standard thickness bituminous sealed cement mortar lining and bituminous outside coating. Fittings for Ductile Iron Pipe shall be mechanical type with standard thickness bituminous sealed cement mortar lining, bituminous outside coating, and ends as required for the types of joints specified or indicated for the various pipe locations and applications.

C.  Valves:

1. All valves and stops shall have ends suited, or adapters shall be provided, for proper installation in lines in which they are located.

2. Valves 2-inch and larger shall be iron-body, bronze or brass mounted double gate valves conforming to AWWA standard specifications C-500. They shall open in same direction as those used in local water works system. Valve stems shall terminate in wrench nuts. Furnish two suitable keys.

3. Valve boxes for 2-inch and larger valves shall be approved standard cast iron, adjustable shaft boxes having minimum shaft diameter of 5-1/2". Castings shall be coated with two coats of coal tar pitch varnish. Lids of all boxes shall bear word "Water", or letter "W".

D.  Meter Vault, Water Meter, and Fire Flow Tap:

1. Prior to bidding, contact local utility company to determine their participation, if any, for providing or installing main taps, water meter, and meter vault, and to obtain fees charged by utility company. Contractor shall pay all costs for utility connections and appurtenances charged by utility companies.

2.02  SANITARY SEWER

A.  Pipe and Fittings - Sanitary Sewer

1. Pipe for sanitary sewer shall be Schedule 40 PVC with DWV fittings for all piping 6" or smaller.

D.P. Culp Center [TBR SBC# 166/005-01-2014A]  33 05 00 - 2
East Tennessee State University  COMMON WORK RESULTS FOR UTILITIES
2. Pipe larger than 6" shall be SDR-35, 3034 PVC pipe and fittings.

3. Manufactured from virgin, National Sanitation Foundation (NSF) approved resin conforming to ASTM D-1784.

4. Unless otherwise specified, all PVC pipe and fittings shall conform to ASTM F-789.

5. The gaskets used for joining PVC sewer pipe shall conform to ASTM F-477.

6. All PVC gravity sewer pipe shall be clearly marked with the Manufacturer's name, nominal diameter, SDR, ASTM D-3034 designation, and NSF approved seal.

2.03 CLEANOUTS

A. Cleanouts shall be 4" raised head brass plug type set in pre-cast concrete valve ring, with 4" cast iron soil pipe and fittings from cleanout down to the horizontal piping, all conforming to the applicable requirements of WASTE, VENT, AND SOIL PIPING, herein-before. See detail on site-utilities drawings.

2.04 SEWER STRUCTURES - SANITARY - MANHOLES, PRE-CAST

A. AASHTO M-199 SR OR ASTM C-478.

B. Manhole Inverts: Construct manhole flow channels of concrete, and of semi-circular section conforming to inside diameter of connecting sewers. Make changes in size or grade gradually and change in direction by true curves. Provide such channels for all connections to each manhole.

C. Openings shall be provided for the required number and size pipes and shall be marked to insure installation at proper locations.

D. Use o-ring joints or "Mastic" joint in accordance with ASTM C-443 or ASTM C-361 at all joints between sections in sanitary sewer manholes.

E. Use Type II cement for increased sulfate resistance.

F. Provide manholes with lift holes that do not completely penetrate the wall of manhole sections.

G. Manhole bases for depths greater than 15' are to be double reinforced wire mesh with a minimum height of 1' of concrete above the pipe opening. Steel in all manhole sections over 15' should meet ASTM C-78 class II or higher. Base sections for manholes over 15' should have an extended bottom slab.
H. Casting for Frame and Covers:

1. Castings for manholes, shall comply with local standards. Castings for sewer structures shall be of tough even grained, soft gray iron class 30, free from burnt-on sand and other injurious defects, and of approximate weight and dimensions shown on drawings. Before leaving foundry, castings shall be thoroughly cleaned, subjected to hammer test for soundness, and given two coats of coal tar pitch varnish. Tops and gratings weighing less than 100 pounds shall have approved locking device.

2. Frames and covers for use on watertight manholes shall be machined to a smooth uniform bearing complete with polyvinyl gasket set inside the bolt circle that will provide a watertight seal.

3. All frame openings shall be full 24” diameter to provide clear access conforming to OSHA regulations.

4. Steps in sewer structures shall conform to local standards and be polypropylene plastic molded around a steel rod, 300 pound live load, with top surface of minimum 10” cleat designed to prevent foot slippage and be a minimum of 4” from wall.

5. Castings by John Bouchard, Neenah, or approved equal.

6. All structures shall conform to Johnson City standards.

2.05 PIPE ENTRANCE COUPLINGS FOR MANHOLES

A. Connections between pipes and manholes shall be watertight, made with flexible gaskets and meeting quality standards of ASTM C-443. Internal aluminum band material shall conform to specification 6061-T6, T651. External band shall be 304 Stainless Steel conforming to ASTM Specification A-167. Use Kom-N-Seal Boot, PSX Boot, or equivalent. Provide connection for all pipes including service connections.

2.06 CHECK DAMS

A. Check dams shall be installed in the bedding and backfill of all new or replaced sewer lines to limit the drainage area subject torench drain effect of gravel bedding. Major rehabilitation projects should also include check dams in the design. Dams shall consist of compacted clay bedding and backfill at least three feet thick to the top of the trench and cut into the walls of the trench two feet. Alternatively, concrete may be used, keyed into the trench walls. Dams shall be placed no more than 500 feet apart.
2.07 NATURAL GAS

A. Contractor shall contact Atmos Energy in Johnson City to determine costs for installation of high pressure gas main, tap, and meter/regulator station at the building and include all costs in bid.

2.08 BACKFLOW PREVENTION

A. Backflow preventer on site shall be reduced pressure zone type with OS & Y gate valves and tamper switches. RPZ shall be installed in an above ground environmental enclosure with insulated panels and slab heater. See detail on drawings.

PART 3 EXECUTION

3.01 TRENCHING AND BACKFILLING

A. Backfill and compact all depressions resulting from clearing and grubbing with suitable materials.
   1. Backfill embankment areas to natural ground elevation.
   2. Backfill excavation areas below finished subgrade to finished subgrade.

B. Perform backfilling a satisfactory distance ahead of construction operations.

C. Prepare areas designated on the drawings to receive erosion control matting to smooth surfaces that have been shaped, fertilized and seeded.

D. Protection:
   1. Protect all private roads and walks and maintain them during course of work. Repair all damage at Contractor's expense.
   2. Erect a wooden barricade around all excavations before starting work.
   3. Provide and maintain guard lights at all barricades, railings, obstructions in streets, roads, or sidewalks, and at all trenches or pits adjacent to public walks or roads.
   4. Remove and replace at Contractor's expense all work damaged by failure to provide required protection.

E. Width of Trench - Excavate trenches of sufficient width for proper installation of work. When depth of backfill over piping exceeds 10 feet, keep trench below level of top of pipe as narrow as practicable.
F. Separate Trenches - Unless otherwise shown or required, provide separate trenches for sewer and water lines. Shelving of water lines above sewer lines is not acceptable. At crossings, water piping must be on top with a minimum of 18" separation between the bottom of the water line and the top of the drainage line. See "Water and Sewer Separation" detail on drawings.

G. Sheeting, Bracing, Water Removal:

1. Sheet and brace trenches, and remove water as necessary to fully protect workmen and adjacent structures and permit proper installation of work. Comply with local regulations or, in absence thereof, with provisions of "Manual of Accident prevention in Construction", of AGC. Under no circumstances lay pipe or install appurtenances in water; keep trench free from water until pipe joint material has hardened. Presence of ground water in soil or necessity of sheeting or bracing trenches shall not constitute a condition for which any increase may be made in the Contract price.

2. Sheeting left in place shall be cut off not less than 2 feet below finished grade. Sheeting shall not be removed until trench is substantially backfilled.

H. Excavation and Bedding - Excavate all pipe trenches to at least six inches below bottom elevation of pipe at all points. Grade trench bottom evenly. Refill bottom of trench with six inches of washed stone for polyvinylchloride and ductile iron piping.

Utilize sand for bedding of copper domestic water line. Make bell holes. Lay piping. Check to see that piping bears uniformly for full length. Refill bell holes or voids and compact bedding. Necessity of refill material shall not constitute a condition for which an increase may be made in Contract Price. Minimum trench width shall be 18" plus outside diameter of pipe bell.

I. Backfilling - Backfill trenches only after piping has been inspected, tested, approved, and location of pipe and appurtenances have been recorded. Backfill by hand around pipe and for a depth of one foot above pipe; use stone to 6" above PVC pipe and sand to 12" above top of domestic cold water copper pipe. See "Water and Sewer Pipe Bedding" details on drawings. Tamp firmly in layers not exceeding 6" in thickness, taking care not to disturb pipe or injure pipe coating. Compact earth for remainder of backfill thoroughly with a rammer of suitable weight or with an approved mechanical tamper. Under pavement, walks, and other surfacing, pipe shall be backfilled completely with crushed stone. Exclude all cinders and rubbish from trenches in which pipes are laid. Compact backfill in trenches.

3.02 DEBRIS REMOVAL

A. Promptly remove cleared debris from site.

B. For disposal of debris, refer to Special Waste Disposal Requirements Documents.
3.03 EXCAVATION TRENCHES

A. Perform in such a manner as to form a suitable trench in which to place the pipe and so as to cause the least inconvenience to the public.

B. Maximum width at the crown of the pipe should be wide enough for 6" rock on each side of the pipe. With trench depth greater than 5', the trench should be 4' wide to accommodate a ditch box or other shoring.

C. Align trench as shown on the Plans unless a change is necessary to miss an unforeseen obstruction.

D. When unstable soil is encountered at the trench bottom, remove it to a depth required to assure support of the pipeline and backfill to the proper grade with coarse aggregate AASHTO M-43, Size No. 2 or 3.

E. Remove rock encountered in trench excavation to a depth of 6 inches below the bottom of the pipe barrel, backfill with an approved material, and compact to uniformly support the pipe. In no case shall solid rock exist within six (6) inches of the finished pipeline.

F. When rock borings or soundings are provided, they are for information only and do not guarantee existing conditions. Make such investigations as deemed necessary to determine existing conditions.

3.04 GRAVITY SANITARY SEWER BEDDING

A. Always maintain proper grade and alignment during the bedding and tamping process.

1. Any pipe dislodged during this process shall be replaced.

2. Dig bell holes to assure uniform support of the pipe.

B. Bedding for PVC Sewers:

1. Completely encapsulate each sewer pipe section with granular material from a distance of 6" below the bottom of the pipe to a distance of 6" above the top of the pipe for the entire width of the ditch, compacted to 60% relative density, ASTM D-2049. Use Class I angular material.

3.05 INITIAL BACKFILLING

A. Do not begin backfilling before the Designer has inspected the grade and alignment of the pipe, the bedding of the pipe, and the joints between the pipes. If backfill material is placed over the pipe before an inspection is made, reopen the trench in order for an inspection to be made.
B. Perform backfilling by hand, together with tamping, until fill has progressed to 18" above the top of the pipe.

1. Deposit Class I granular material (where required) or loose soil free from lumps, clods, frozen material or stones in layers approximately 6" thick.

2. Compact by hand or with manually operated machine tampers actuated by compressed air or other suitable means.

3.06 FINAL BACKFILLING

A. Backfill material up to three feet above the top of the pipe should not exceed 6 inches in diameter at its greater dimension.

B. After the backfill has reached a point 18" or more above the top of the pipe, perform final backfilling depending upon the location of the work and danger from subsequent settlement.

C. Backfilling in Unimproved Areas:

1. Dispose of and replace all soft or yielding material which is unsuitable for trench backfill with suitable material.

2. Deposit backfill to the surface of the ground by dragline, bulldozer, or other suitable equipment in such a manner so as not to disturb the pipe.

3. Neatly round sufficient surplus excavated material over the trench to compensate for after settlement.

4. Dispose of all surplus excavated material, per Special Waste Disposal Document Requirements.

5. Prior to final acceptance, remove all mounds to the elevation of the surrounding terrain.

D. Backfilling Beneath Driveways and Streets where Non-Rigid and Rigid Type Surfacing is to be Replaced:

1. Use select backfill material, crushed limestone, or crushed gravel of high weight and density.

2. Carefully deposit in uniform layers, not to exceed 12" thick, compacted to at least 95 percent standard proctor but not less than a minimum of 90 lb/ft³ dry density.

3. Compact each layer thoroughly by rolling, ramming and tamping with tools suitable for that purpose in such a manner as to not disturb the pipe.
3.07 WATER DISTRIBUTING SYSTEM INSTALLATION

A. Connections to Existing Mains - Contractor shall make arrangements with Local Utility Co. for connection to existing water main, installation of service, meter and meter box, and valves and valve boxes. Installation shall be in accordance with requirements of the Utility Co. and Contractor shall pay all costs. Provide written acceptance from Water Utility Company.

B. Handling and Storing Materials - Unload cast iron pipe by hoists or skidding so as to avoid shock or damage. Handle and store all pipe in such manner as to avoid deformation or other injury thereto. Place no pipe within pipe of a larger size. Store pipe and fittings on sills above storm drainage level and deliver for laying after trench is excavated. Valves and hydrants shall be drained and stored as to protect them from freezing.

C. Pipe Laying: General - Interior of pipe shall be clean and joint surfaces wiped clean and dry when pipe is lowered into trench. Hammer-test cast iron pipe for soundness before lowering. Lower each pipe, fitting and valve into trench carefully and lay true to line and without objectionable breaks in grade. Insert a water tight plug in open end of piping when pipe laying is not in progress.

D. Fittings and Branch Connections - Install suitable fittings at all changes in directions, dead ends, and branch connections.

E. Setting Valves - Before setting each valve make sure interior is clean and test opening and closing. Set valve and stops with stems plumb and at exact locations shown. Provide a brick laid flat or other similar foot piece under each curb box. Valve and service boxes shall be plumb with tops at finished grade.

F. Blocking - Pour concrete thrust blocks per requirements of NFPA 24 Table 9605 between undisturbed trench face and plugged ends, and bends, to prevent pipe movement at joints; where soil is not firm, provide in lieu of concrete, approved tie rods and collars, painted with coal tar pitch varnish after placing.

G. Insulated Fitting and Wrapping - Where copper pipe connects to cast iron pipe or other ferrous pipe, provide a brass electrically insulated fitting. Wrap fitting and copper pipe for two feet from fitting with dielectric tape.

H. Tests - Before joints are covered, fill piping with water, opening hydrants or other outlets as necessary for expelling entrapped air. Thereafter, furnish necessary equipment and test piping, under supervision of Local Authority, for a period of at least 2 hours at a pressure of 150 pounds per square inch. Inspect all joints, and remedy to satisfaction of Local Authority any defects discovered. Continue tests until all visible leaks, except as hereinafter specified, have been eliminated from part of system under test.
I. Flushing Mains - Immediately upon completion of water distribution system test all valves to insure their full opening and flush out system as follows: Open fire hydrant nearest connection to existing system and permit flow to continue until water runs clear. Thereafter, repeat operation at next hydrant and proceed in order to hydrant farthest from source of supply. Use outlets in buildings to flush upper ends of mains and service lines. During such flushing operation Local Authority may test flows from hydrants and, before final acceptance of work, make further tests of hydrant flows to ascertain if lines are clear.

J. Sterilization of Water Distribution System - As soon as water distribution system has been flushed out as above specified, it shall be sterilized by following or other method satisfactory to Local Authority.

1. Introduce chlorine or a solution of calcium or sodium hypochlorite, filling lines slowing and applying sterilizing agent at a rate of 50 parts per million of chlorine, as determined by residual chlorine tests at end of lines. Open and close all valves and hydrants while system is being chlorinated.

2. After sterilizing agent has been applied for 24 hours, test for residual chlorine at end of lines. If less than 5 p.p.m is indicated, repeat sterilization process.

3. When tests show at least 5 p.p.m. of residual chlorine, flush out system until all traces of chemical used are removed.

4. Local Authority reserves right to test water again at any time prior to final acceptance of work, if found unsafe bacteriologically, to require Contractor to re-chlorinate system until water is proven equal to that supplied by public system.

3.08 SEWER CONNECTION

A. Sewer Pipe Laying:

1. Commence at lowest point in system and lay pipe with bell or groove and upgrade. Test pipe for soundness and clean interior and joint surfaces before lowering pipe into trench. Lay pipe in straight lines and on uniform grades between points where changes in alignment or grade are shown. Bed pipe barrel uniformly (see "Trenching and Backfilling" above).

Check line and invert grade of each pipe from a top line carried by batter boards not over 25 feet apart. Fit pipe to form a smooth uniform invert. Laser beam method for obtaining alignment and grades is also approved. All testing shall be approved before backfilling is started.
B. Flushing Sewers:

1. Flush all sanitary sewers, except building connections, with water in sufficient volume to obtain free flow through each line. Remove all obstructions and correct all defects discovered. Remove all silt and trash from catch basins and inlets just prior to final acceptance of work.

3.09 INITIAL PROOF TESTING OF SANITARY SEwers

A. It is the intent to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance.

B. Before a reach of pipeline is approved for payment, successfully proof test that reach for grade, alignment, cleanliness, and leakage.

C. In the event that four or more reaches fail to satisfactorily pass proof testing procedures, cease pipe laying until deficiencies are identified and corrected.

D. The basis for grade, alignment and cleanliness testing will be visual inspection. Leakage testing will be by means of low pressure air as specified hereinafter.

1. Proof test flexible pipeline inhalation for deflection by pulling a "go-no-go" test mandrel through the line after the initial backfill has been in place at least 24 hours. No pipe shall exceed a deflection of 5%. The test shall be run with a rigid ball or an engineer-approved 9-arm mandrel having a diameter equal to 95% of the inside diameter of the pipe. The test must be performed by manually pulling the test device through the line.

E. Manholes will be inspected and tested by the Designer before or during incorporation in the work. However, the inspection and testing of manholes shall not relieve the Contractor of the responsibility for furnishing material that conforms to the specifications. The Owner may retest all materials that have been accepted at the source after delivery and may reject those that do not conform to the specifications. Stored manholes may be re-inspected prior to use. Work in which untested manholes are used without the written permission of the Designer may be considered unacceptable.

3.10 FINAL TESTING

A. Before the job is accepted and before house services are connected, a final testing procedure is to be followed.

B. All sewers and manholes shall be built practically watertight and the Contractor shall adhere rigidly to materials and workmanship. After completion of certain line segments, the Contractor shall immediately air test sections thereof. If leakage is above limits specified, the sewer will be replaced. The Owner may request infiltration/exfiltration tests after project completion on selected line segments but all line shall be first air tested.
C. Prior to acceptance of completed sewer lines, the lines shall be inspected and tested to ensure compliance with the following provisions. After the sewer lines have been brought to completion and prior to final inspection, the Contractor shall clean out the downstream segments. Each individual line will be cleaned by pushing appropriate tools from manhole to manhole to remove any and all debris and obstructions or may, if possible, flush clean with water or remove by hand. Water may be turned into the system to determine whether the completed lines are true to line and grade as laid out or as shown on the drawings. All lines or sections of lines that are laid with improper line or grade, that contain broken sections of pipe, that are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, or are deflected in excess of the allowable, shall be removed and replaced.

D. Low Pressure Air Test: Test entire system as follows:

1. The section of sewer to be tested shall have been backfilled.

2. Both ends of the pipe section being tested shall be sealed airtight.

3. Pressurize the sealed pipe to 4 psig above the average back pressure of ground water over the sewer pipe at the time of the test and allow the air pressure to stabilize for at least two minutes.

4. After the stabilization period, adjust the pressure to 3.5 psig and measure the time in minutes and seconds for the pressure to drop to 2.5 psig. If ground water is present, the starting air pressure shall be increased to 3.5 psig above the level of the ground water and the time measured.

5. The time measured for the pressure drop to occur shall be not less than that shown in the following table:

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E. Repair or replace any line that fails any of the above tests and retest.

F. Sewer service assemblies shall be installed and capped at locations directed by the Designer, and shall be included in Final Testing.

G. All test shall be witnessed by the Inspector representing the Johnson City Water and Sewer Services Engineering Department.
H. Vacuum Testing for Manholes

All precast manholes including frames shall be vacuum tested as follows:

1. Manholes should be tested after assembly and prior to backfilling.

2. All pipe openings shall be plugged by pneumatic or mechanical plugs and braced to sustain 10" mercury vacuum. The rim to cone joint shall be tested on all manholes with watertight covers. No one shall be inside the manhole during testing. The test shall be at 10 in. mercury.

3. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specification for which performance information has been provided by the manufacturer and approved by the City of Johnson City Water and Sewer Services Department.

Minimum Time to Hold 1 in. Mercury Drop

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<thead>
<tr>
<th>MH Dia.</th>
<th>MH height</th>
<th>Time Hg (minimum)</th>
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<tbody>
<tr>
<td>4'</td>
<td>10' or less</td>
<td>1 in. 1 min. 0 sec.</td>
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<tr>
<td>4'</td>
<td>10-15'</td>
<td>1 in. 1 min. 15 sec.</td>
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<tr>
<td>4'</td>
<td>15-25'</td>
<td>1 in. 1 min. 30 sec.</td>
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4. If the manhole fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test or the manhole shall be tested in accordance with the standard exfiltration test and rated accordingly. All leaks shall be sealed from the outside of the manhole. No visible leaks shall be observed inside the manhole.

3.11 SEWER MANHOLES - GENERAL

A. Unless otherwise specified, all manholes shall have an inside diameter of not less than 4 feet and a vertical wall height of not less than 2.5 feet.

B. The clear opening in the manholes shall be not less than 2.0 feet.

C. Depth of the manhole shall be the vertical distance from the lowest invert in the manhole to the top of the frame and cover assembly.

D. Backfill manholes with the same material used for pipelines.

E. Mechanically tamp Class I material a distance of at least on full pipe length to prevent settlement of pipelines.

F. Frame and cover shall not be installed in curb lines.
3.12 STANDARD PRECAST CONCRETE MANHOLES

A. ASTM C-478, with o-ring joints or "Double Mastic" joints in accordance with ASTM C-433 or ASTM C-361 and manufacturer's recommendation. Use Type II cement.

B. The base of the manhole shall be Class C concrete not less than 8" in depth with inverts not less than 4" depth.

C. Shape manhole inverts from Class B concrete to be smooth, accurately shaped, and in accordance with the Plans. Inverts shall be of such shape and slope to provide smooth transition between inlet and outlet sewers and to minimize turbulence. Channeling height shall be to the spring line of the sewers. Benches shall be sloped from the manhole wall toward the channel to prevent accumulation of solids.

D. Inlets and outlets from each manhole shall drop 0.10 foot across the manhole and shall be finished smooth and flush with the sides of the manhole walls so as not to obstruct the flow of liquid through the manhole.

E. When possible, the base of the manhole shall sit on dry, consolidated and undisturbed soil.

F. When wet or unconsolidated material occurs or when over-excavation of the base occurs, provide a subbase with minimum of 12" of Class I, granular material, well compacted with mechanical tamping equipment.

G. When completed the manhole shall be free from channel obstructions and leakage.

H. Use of concrete grade rings will be limited to a vertical height of eight to twelve inches, with joints between each ring sealed with preformed gasket material.

I. If manhole does not pass vacuum test then all section joints shall be grouted inside and outside.

J. All manholes shall be vacuum tested prior to backfilling operations.

3.13 MANHOLE STEPS

A. Materials for manhole steps should be highly corrosion resistant meeting ASTM C-478 standards. The use of galvanized steel should be avoided and aluminum or plastic with reinforcing bar is preferred.

B. Set manhole steps at intervals of 15 inches along the wall of the manhole.

C. The treads of the steps shall be free from mortar or other material when the manhole is completed.

D. In precast manholes, the holes left to receive the steps shall be mortared smooth following placement of the steps.
E. Steps shall be installed in a straight line.

F. Steps shall be oriented in plain view to accommodate proper positioning of frame and cover.

3.14 MANHOLE FRAMES AND COVERS

A. Seal manhole frames and covers in place with mastic.

B. The bearing surfaces between cast frames and covers shall be machined, fitted together, and match marked to prevent rocking.

C. All castings shall be of the types, dimensions and weights as shown on the plans and shall be free of faults, cracks, blowholes, or other defects.

3.15 DROP MANHOLE ASSEMBLIES

A. Drop manhole assemblies shall be constructed as outlined on the plans.

B. The material used in the drop pipe construction shall be ductile iron and class "B" concrete.

C. Concrete shall completely encase the drop to a height of 2' above bend to prevent dislodging.

D. Inside drops will be used only where shown on the plans or specifically approved by the Johnson City Water and Sewer Services Engineering Department.

3.16 FINAL INSPECTION

A. At time of final inspection of work performed under Contract, utilities covered by this Division shall be complete in every respect and in perfect operating condition. All surplus material of every character resulting from the work of the Division shall have been removed. Sanitary and storm sewers shall be free from sand, silt or other obstructions. Any defects discovered in the utilities to this inspection shall have been corrected. City of Johnson City shall be notified for inspections.

END OF SECTION
SECTION 33 27 20
SITE DRAINAGE SYSTEM

PART 1  GENERAL

1.01  WORK INCLUDED

A. Pipes, culverts and fittings, complete. Catch basins, drop inlets, manholes, end walls and other structures, complete as shown on drawings. Ditch protection and bracing requirements to conform to OSHA requirements and regulations. Piping and drains for sediment basins.

B. Related Work Described Elsewhere:

1. Site Preparation: Section 31 00 00
2. Earthwork: Section 31 20 00
3. Excavating, Backfilling and Compaction: Section 31 22 00
4. Erosion & Sediment Control: Section 31 25 00

PART 2  PRODUCTS

2.01  CONDUIT AND EMBEDMENT MATERIALS

A. Furnish fittings of same type and class of material as conduit.

B. Reinforced Concrete Pipe (RCP): ASTM C76, Class III. This pipe may be used in lieu of PVC.

C. Corrugated Metal Pipe (CMP): Helically corrugated 16 gauge galvanized metal uncoated, and conforming to AASHTO-M36. Pipe shall have rerolled ends.


E. Corrugated Polyethylene Pipe: High density polyethylene, corrugated exterior/smooth interior, 12 inch to 36 inch diameters conforming to AASHTO M252 with the addition that the pipe have a smooth interior liner. Material conform to ASTM D3350. Pipe equal to Hi-Q pipe as manufactured by Hancor, Inc.

F. Contractor has the option of using reinforced concrete pipe, polyvinyl chloride pipe or corrugated polyethylene for storm drainage except where pipe is encased in concrete. Do not substitute corrugated metal pipe for any of the above mentioned pipe.

G. Crushed Stone Pipe Bedding Materials: Size #7 or #8.
2.02 CONCRETE MATERIALS

A. Concrete Base: Pre-Cast or Cast-In-Place concrete, at Contractor's option. Use concrete which will attain a 28-day compressive strength of not less than 3,000 psi.

B. Pre-Cast Concrete Structures: ASTM C478, sizes as indicated, eccentric cone pre-cast top, unless otherwise indicated. Pipe openings of proper size shall be carefully and accurately cut in or cast in.

2.03 MASONRY MATERIALS

A. Manhole and Catch Basin Brick: ASTM C32, Grade MS.

B. Sewer Brick: ASTM C32, Grade SS.

C. Masonry Mortar: ASTM C270, Type M. For minor amounts, use packaged materials complying with ASTM C387, Type M.

2.04 METAL ACCESSORIES

A. Manhole Frames and Covers: Grey cast-iron, ASTM A48, Class 30B. Comply with requirements of TDOT for type and style unless otherwise indicated, and equal to J.R. Hoe & Sons, Middlesboro, KY, #MC-325.

B. Catch Basin Frames and Gratings: Grey cast iron, ASTM A48, Class 30 or better. Comply with requirements of TDOT for type and style unless otherwise indicated, and equal to J.R. Hoe and Sons.

C. Curb Inlet and Gratings: Comply with requirements of TDOT for type and style unless otherwise indicated, and equal to J.R. Hoe & Sons.

2.05 EROSION CONTROL STONE

A. Rip Rap: Refer to Section 31 25 00, Erosion Control.

2.06 SUB-DRAIN MATERIALS

A. Polyethylene perforated tubing and fittings shall conform to SCS National Engineering Standard, Code 606, as manufactured by Hancor, Inc., or equal.

B. ASTM F405 or F867, AASHTO M252 or M294, and SCS 606.

C. Filter Stone: Open graded, washed stone such as ASTM No. 57.

D. Filter Sand: Clean concrete sand.

E. Filter Fabric: "Typar".

2.07 DOWNSPOUT BOOTS

A. Downspout boots to be McKinley Standard Cast Iron with one coat of rust inhibitive primer, Type D54. Provide sizes to accommodate downspouts.

PART 3 EXECUTION

3.01 INSPECTION

A. Installer must examine areas and conditions under which storm sewer system work is to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.02 DRAINAGE STRUCTURES

A. Install at locations indicated and to required elevations. Set rectangular frames square with the nearest wall, building or pavement.

B. Where an inlet is part of the temporary erosion and sediment control measures, leave structure top below grade or leave temporary opening in side to collect water from silt basin sump. Complete installation after basin is no longer required.

3.03 TRENCHING

A. General:

1. Perform all trenching required for the installation of items where the trenching is not specifically described in other sections of these specifications.

2. Make all trenches open vertical construction with sufficient width to provide free working space at both sides of the trench and around the installed item as required for caulkung, joining, backfilling, and compacting.

B. Depth: Trench as required to provide the elevations shown on the drawings. Where elevations are not shown on the drawings, trench to sufficient depth to give a minimum of 18" inches of fill above the top of the pipe, measured from the adjacent finished grade.

C. Correction of Faulty Grades: Where trench excavation is inadvertently carried below proper elevations, backfill with material approved by the Designer, and then compact to provide a firm and unyielding subgrade and/or foundation to the approval of the Designer and at no additional cost to the Owner.
D. Trench Bracing:

1. Properly support all trenches in strict accordance with all pertinent rules and regulations including current OSHA excavation and trench safety standards. The existing soil on the site should be classified as a Class C soil type.

2. Brace, sheet, and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle, and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.

3. In the event of damage to such improvements, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.

4. Arrange bracing, sheeting, and shoring so as to not place stress on any portion of the completed work until the general construction thereof has proceeded far enough to provide sufficient strength.

E. Removal of Trench Bracing: Exercise care in the drawing and removal of sheeting, shoring, bracing, and timbering to prevent collapse and caving of the excavation faces being supported.

F. Grading and Stockpiling Trenched Material: Control the stockpiling of trenched material in a manner to prevent water running into the excavations. Do not obstruct surface drainage, but provide means whereby storm and waste waters are diverted into existing gutters, other surface drains, or temporary drains.

G. Foundation for Pipes:

1. General: Grade the trench bottoms to provide a smooth, firm, and stable foundation free from rock points throughout the length of the pipe.

2. Foundation Material: Place a minimum of six (6") inches of the specified cohesionless material in the bottom of the trench.

3. Subsurface Conditions: In areas where soft, unstable materials are encountered at the surface upon which cohesionless material is to be placed, remove the unstable material and replace it with material approved by the Designer. Make sufficient depth to develop a firm foundation for the item being installed.

4. If the need for such over excavation has been occasioned by an act or failure to act on the part of the Contractor, make the over excavation and replacement at no additional cost to the Owner.
5. Shaping: At each joint in pipe, recess the bottom of the trench as required into the firm foundation in such a manner as to relieve the bell of the pipe of all load and to ensure continuous bearing of the pipe barrel on the firm foundation.

6. Accurately shape all pipe subgrade and fit the bottom of the trench to the pipe shape. Use a drag template shaped to conform to the outer surface of the pipe if other methods do not produce satisfactory results.

H. Bedding for Pipes:

1. General: Place the specified cohesionless material in the trench, simultaneously on each side of the pipe for the full width of the trench, to a maximum depth of three feet and a minimum depth of one foot above the outside diameter of the pipe barrel.

2. Densification: Densify the bedding material after placing by slicing with a shovel.

3. Take special care to provide firm bedding support on the underside of the pipe and fittings for the full length of the pipe.

I. Backfill for Pipes:

1. Using On Site Materials: After the pipe has been thoroughly bedded and covered, spread the on site material in uniform lifts of not more than eight (8") inches in uncompacted thickness, and then compact as specified in this section. Repeat the spreading and compacting procedure until adjacent grade level is attained.

3.04 INSTALLATION OF PIPE

A. General: Install pipe in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated. Inspect pipe before installation to detect any apparent defects. Mark defective materials with paint and promptly remove them from the site.

B. Lay pipe beginning at the low point of a system, true to the grades and alignment indicated with unbroken continuity of invert. Place bell ends or groove ends of pipe facing upstream. Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements and other special installation requirements.

C. Installation by Type of Pipe:

1. Concrete Pipe: Install in accordance with applicable provisions of the American Concrete Pipe Association "Concrete Pipe Field Manual", unless otherwise indicated.
2. Plastic Pipe & Corrugated Polyethylene Pipe: ASTM D2321-89, with compacted stone aggregate bedding, and in accordance with pipe manufacturer's written instructions.

3. Refer to drawings for backfill and bedding requirements.

3.05 CLEANING PIPE

A. Clear the interior of pipe of dirt and other superfluous material as the work progresses. Maintain a swab or drag in the line and pull past each joint as it is completed. Flush lines between structures to remove collected debris. Place plugs in the ends of uncompleted pipe at the end of the work day.

3.06 INTERIOR INSPECTION

A. Inspect pipe to determine if line displacement or other damage has occurred. Inspect lines between manholes or structures after approximately two feet of backfill is in place, and again at completion of the project. If the inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects.

3.07 STRUCTURES

A. Masonry Construction (Contractor's option in lieu of concrete unless otherwise indicated):

1. Use sewer brick to construct masonry manholes. Mix mortar with only enough water for workability. Retempering of mortar will not be permitted. Keep mortar mixing and conveying equipment clean. Do not deposit mortar upon, or permit contact with, ground.

2. Lay masonry in mortar so as to form full bed with ends and side joints in one operation, and with full bed and vertical joints, not more than 5/8 inch wide. Protect fresh masonry from freezing and from too rapid drying. Where structures occur, set tops of frames and covers flush with finish surface.

B. Pre-Cast Concrete Construction (Contractor' option in lieu of masonry, unless otherwise indicated):

1. Place pre-cast concrete sections as shown on the drawings. Where manholes, set tops of frames and covers flush with finish surface. Use epoxy bonding compound where manhole steps are mortared into manhole walls. Provide rubber joint gasket complying with ASTM C433 or apply bituminous mastic sealant at joints of sections.

C. Poured In Place Concrete: In accordance with Division 03.
3.08 EROSION CONTROL STONE

A. Install filter cloth then hand place rip rap as indicated.

3.09 TESTING

A. Perform testing of completed conduits and structures in accordance with local authorities having jurisdiction and the Designer. Correct unsatisfactory conditions.

END OF SECTION
SECTION 33 46 13

FOUNDATION DRAINAGE SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide foundation drainage at below grade walls adjacent to inhabited space. Drainage pipe shall be perforated polyvinyl chloride pipe and shall be placed on crushed stone and surrounded by drainage fill. Drainage fill material shall be overlaid with layer of filter fabric before placement of finish soil materials.

END OF SECTION